Canada

Report of the Task Force on the Surveying and Mapping Industry in Canada

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REPORT OF THE TASK FORCE

ON THE SURVEYING AND MAPPING INDUSTRY IN CANADA

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Prepared for
The Department of Regional Industrial Expansion

By
The Canadian Institute of Surveying

With assistance from
The Canadian Association of Aerial Surveyors
The Canadian Council of Land Surveyors
The Canadian Association of Hydrographic
and Ocean Surveying Industries
The Canadian Hydrographers Association
and
The Canadian Cartographic Association

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PREFACE

". . . and information has become perhaps the world's fastest growing and most important business". (The Third Wave - Alvin Toffler - 1979).

"Although we continue to think we live in an industrial society, we have in fact changed to an economy based on the creation and distribution of information". (Megatrends - John Naisbitt - 1982).

"The information society is upon us. The manner in which Canadians choose to participate will have far-reaching implications. The micro-electronics revolution, upon which the information society is predicated, presents both threats and opportunities. How we respond will determine the shape of our own lives and Canada's future role in the world community." (Planning Now for an Information Society - Tomorrow is too Late, Science Council of Canada, 1982)

The information age is here, and with it new challenges for those who are involved in the process of gathering, storing and disseminating information. The primary function of the surveying, mapping and related industries is creating, gathering, storing and analyzing information about our environment, and presenting that information in ways that are most useful to society. Society is demanding more up to date information of all kinds, and in particular information about our physical environment. This increased demand for information, together with the utilization of space age technologies, is changing the very concept of surveying and mapping. The challenge will be to embrace the change, and to grasp the opportunities it presents.

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The members of the Task Force wish to acknowledge the invaluable assistance and contributions given by a large number of persons and organizations in the preparation of this report. Specifically, the members of the Task Force extend their most sincere thanks to:

- all those who responded to the various questionnaires;
- the 45 persons or groups who devoted the time and energy to the preparation and presentation of briefs;
- the 87 individuals and groups of persons who contributed their insights and perspectives by way of interviews with members of the Task Force.

The national surveying and mapping associations provided financial assistance, mailing lists and other information respecting their disciplines. The Task Force acknowledges their assistance and co-operation and extends thanks to:

The Canadian Association of Aerial Surveyors
The Canadian Council of Land Surveyors
The Canadian Association of Hydrographic and Ocean Surveying Industries
The Canadian Hydrographers Association
The Canadian Cartographic Association

EXECUTIVE SUMMARY

The surveying and mapping industry encompasses the disciplines of land surveying, geodetic surveying, photogrammetry, hydrography, cartography, engineering surveying, mining surveying, geophysical surveying, remote sensing and spatial information management. The private sector surveying and mapping industry employs about 9 000 persons and generates annual sales of approximately $340 million including about $60 million in the export market.

Canadians are world leaders in the fields of surveying and mapping. They have pioneered the development of many new technologies including digital mapping, satellite and inertial positioning systems, information systems and remote sensing. This leadership role is being challenged by others, however, and a concerted effort will be required to maintain or improve the competitive position of the surveying and mapping industry both in Canada and abroad.

The surveying and mapping industry is experiencing a transition from being labour intensive and relatively unsophisticated to being a highly technical and capital intensive industry. This transition is presenting new challenges and opportunities for all the surveying and mapping disciplines.

The major findings and recommendations of the Task Force deal with:

- organization of the industry
- expansion of the export market
- education of personnel
- spatial information management
- technological change

Organization of the Industry

The surveying and mapping industry in Canada consists of 10 different disciplines and supports 24 separate provincial and national organizations, which are primarily concerned with the professional and technical aspects of surveying and mapping, with very little emphasis on the economics of the industry. The Task Force is recommending that the various disciplines recognize that they are in fact all involved in some aspect of the same business - that of gathering, storing, disseminating and managing information concerning our physical environment. This reality is becoming more and more evident with the evolution and development of spatial information systems. The establishment of an umbrella organization which would bring together all the existing groups in one Canadian Survey Federation should be the ultimate goal. As a step in this direction the Task Force is recommending the establishment of the National Administrative Centre for Surveying and Mapping to effect economies through more effective utilization of office space, office equipment and administrative personnel, and to improve lines of communication amongst participating organizations.

The Task Force has identified an urgent need for a national organization which would promote the interests of the surveying and mapping industry, both in Canada and abroad, and is recommending the establishment of the Surveying and Mapping Consulting Association of Canada. This association would represent the whole industry with respect to public relations, marketing and communication with governments, and would generally concern itself with the economic and commercial interests of the industry.

Expansion of the Export Market

Canada has traditionally been recognized as a world leader in the field of surveying and mapping, and the Canadian surveying and mapping industry has captured a substantial share of the total world market for these services. However, these positions are being threatened, and the Task Force has made a number of recommendations aimed at improving opportunities for the surveying and mapping industry in the export market.

Education of Personnel

The evolution of spatial information systems and the accelerating rate of technological change are presenting unprecedented challenges to educational institutions. More emphasis will be required on multi-disciplinary approaches to surveying and mapping, and there is a need to focus on spatial information management. Technological change means higher educational costs with respect to learning the new technologies and providing adequate instructional facilities. The Task Force has made recommendations for dealing with these challenges.

Spatial Information Management

The information age described by several futurists is becoming a reality and the demand for more and more information about our environment is presenting an unprecedented challenge and opportunity to the surveying and mapping industry. There is a need to focus the resources of all disciplines within the industry on the transition from the traditional role of surveying and mapping to a role with more involvement in the development and management of spatial information systems. This will require the full co-operation of government agencies, educational institutions, all surveying and mapping professional and technical organizations, and all those engaged in the various disciplines of the surveying and mapping industry.

Technological Change

The impact of technological change is presenting new challenges for surveying and mapping in both the private and public sectors. Many of the traditional surveying, mapping and charting methods are being replaced by sophisticated new technologies. The problem for the industry is that in order to remain competitive in both the domestic and foreign markets there is a need not only to utilize the best technical equipment and technical expertise available, but also to continue to research and develop new technologies.

Summary of Recommendations

Recommendation 1 (p. 25):

That surveying and mapping firms should provide opportunities for management personnel to attend courses on business management.

Recommendation 2 (p. 32):

That government allocate supplementary funding to surveying and mapping educational programs to enable educational institutions to cope with rapidly changing technology.

Recommendation 3 (p. 32):

That educational institutions make full use of advisory committees in the development of closer ties with industry with respect to (1) utilization of industry technical equipment and expertise on a part time basis for educational purposes, and (2) the development of on-the-job training and experience for educators in government surveying and mapping agencies and in private firms.

Recommendation 4 (p. 33):

That educational institutions place greater emphasis on giving students a sound background in the development, management and utilization of information systems, and that curricula stress the integration of multiple sets of data into spatial information systems.

Recommendation 5 (p. 33):

That educational institutions place greater emphasis on the development of communication skills at both professional and technical levels.

Recommendation 6 (p. 34):

That both the professional and technical curricula of educational institutions reflect the growing reality of a multi-disciplinary approach to surveying and mapping.

Recommendation 7 (p. 35):

That education programs for surveying and mapping be revised to give more emphasis to the applied geography dimension, especially in providing some understanding of the information needed by resource managers and explaining how to disseminate and present this information effectively.

Recommendation 8 (p. 48):

That federal and provincial government funding for research and development in the field of surveying and mapping be increased to 5 per cent of surveying and mapping budgets.

Recommendation 9 (p. 48):

That the National Research Council establish a standing committee on research and development in surveying and mapping with representation from government, industry and education. The committee would be responsible for the identification of research and development priorities, for the co-ordination of research programs and for the development of standards for surveying and mapping and spatial information systems.

Recommendation 10 (p. 50):

That a conference on research and development strategies for surveying and mapping be initiated and organized by the Canadian Institute of Surveying with participation by other organizations such as the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Association of Hydrographic and Ocean Surveying Industries, the Canadian Hydrographers Association, the Canadian Cartographic Assocation, the National Advisory Committee on Control Surveys and Mapping, the Canadian Council on Surveying and Mapping, the universities and all government and private surveying and mapping research agencies.

Recommendation 11 (p. 51):

That governments, universities and industry, co-ordinated by the Canadian Institute of Surveying, jointly develop a strategy whereby the transfer of new technology could be achieved by moving people from one sector to another. The development of this strategy could be discussed at the proposed conference on research and development strategies (see Recommendation 10).

Recommendation 12 (p. 53):

That the surveying and mapping industry avail themselves of government sponsored research assistance programs such as the Industrial Research Assistance Program (IRAP) and the Program for Industry Laboratory Projects (PILP) administered by the Industry Development Office of the National Research Council.

Recommendation 13 (p. 54):

That curricula in university surveying and mapping programs reflect the need for the development of management skills for the high tech environment.

Recommendation 14 (p. 57):

That Government agencies substantially increase the level of contracting out of surveying and mapping projects to the private sector.

Recommendation 15 (p. 57):

That governments and industry work together to develop revised contracting out procedures that are satisfactory to both parties and that will, in the longer term, be beneficial to both government and industry.

Recommendation 16 (p. 57):

That governments clearly enunciate contracting out policies, and establish longer term (five years or more) surveying and mapping programs to enable industry to make the necessary commitments with respect to personnel and technical equipment.

Recommendation 17 (p. 57):

That governments contract out substantially more of their research and development requirements to the private sector and to universities.

Recommendation 18 (p. 57):

That the surveying and mapping industry develop performance standards which members would be expected to conform to, and that a mechanism be established to ensure that these standards are enforced.

Recommendation 19 (p. 58):

That the Ministry of State for Science and Technology conduct an evaluation of the Science and Technology contracting out policy which was enunciated in 1978, and that the policy be reaffirmed and fully implemented.

Recommendation 20 (p. 58):

That the federal and provincial governments provide increased support to the industry in the development of the export market for surveying and mapping services.

Recommendation 21 (p. 60):

That the surveying and mapping industry avail itself more of the funding available through the Program for Export Market Development (PEMD) to send executives as industry representatives to international trade symposia and on market identification trips.

Recommendation 22 (p. 60):

That the member firms of the surveying and mapping industry communicate on a regular basis with sector specialists at the Department of Regional Industrial Expansion and with the geographical desk officers at the Department of External Affairs to keep them informed of their capacities and capabilities and their participation in projects both in Canada and abroad.

Recommendation 23 (p. 60):

That the Canadian Institute of Surveying invite representatives from industry, governments, and universities to participate in a seminar on the development of a national policy and a unified strategy for the export of surveying and mapping services.

Recommendation 24 (p. 60):

That the surveying and mapping industry co-operatively prepare a comprehensive directory of Canadian surveying and mapping companies which have the interest and capacity and capability to participate in foreign markets. The directory should give a detailed description of each firm and should be distributed widely to trade commissioners, embassies, consulates and any other Canadian federal or provincial offices overseas.

Recommendation 25 (p. 63):

That a National Administrative Centre for Surveying and Mapping be organized by the Canadian Institute of Surveying, with membership consisting of the CIS, CCLS, CAAS, CAHOSI, CHA, CCA, CACSTTO and any other surveying and mapping organizations which might qualify for participation.

Recommendation 26 (p. 64):

That those private sector firms that offer surveying and mapping services to the public form the Surveying and Mapping Consulting Association of Canada.

Recommendation 27 (p. 65):

That the Canadian Institue of Surveying, the Canadian Council of Land Surveyors and the Canadian Association of Certified Survey Technicians and Technologists jointly explore mutually acceptable ways of making provisions for the official recognition of technicians and technologists.

Recommendation 28 (p. 75):

That the Canadian Council on Surveying and Mapping should take a lead role in co-ordinating the development of spatial information systems and distributed information networks, and that it should give special attention to the need to develop standards for the exchange and effective utilization of spatial information.

Recommendation 29 (p. 75):

That the private sector surveying and mapping firms focus their resources on the transition from their traditional role to one of more involvement in spatial information management.

Recommendation 30 (p. 76):

That the Canadian Institute of Surveying take an active role in encouraging and assisting the surveying and mapping industry to become more involved in spatial information systems by publishing relevant papers, sponsoring seminars, organizing educational courses, and generally creating an awareness of the need to become involved.

Recommendation 31 (p. 76):

That universities and technical institutes review and revise their undergraduate and graduate programs to emphasize and focus on the objective of shifting the role of the surveying and mapping community to one consisting of the development, maintenance and management of spatial information systems.

Recommendation 32 (p. 76):

That universities and technical institutes develop courses on the development, maintenance and management of spatial information systems for practising surveyors and mappers in both the public and private sectors.

Recommendation 33 (p. 76):

That the Canadian Institute of Surveying assume responsibility for the development and co-ordination of continuing education programs in the science of spatial information management.

Recommendation 34 (p. 77):

That the Canadian Institute of Surveying assume a leadership role in ensuring that the recommendations in this report are acted upon.

1. INTRODUCTION

1.1 Background to the Study

The surveying and mapping industry in Canada consists of those firms engaged in land surveying, geodetic surveying, photogrammetry, hydrography, cartography, engineering surveying, mining surveying, remote sensing (including aerial photography), airborne geophysical surveying and spatial information management.

This study was prompted by concerns expressed within the surveying and mapping industry with respect to:

- the task of fulfilling the demands of a rapidly emerging information society;
- the challenge of keeping ahead and effectively utilizing new technologies in a period of rapid technological change;
- the impact of space age technologies on individuals, and the effect of technological change on employment opportunities for those engaged in the broad field of surveying and mapping;
- the effects of the current weak economy on the industry;
- the capacity of the industry to compete effectively in a competitive world market;
- the education of those engaged in the industry;
- the impact of government programs and policies on the industry.

The Task Force Study on the Surveying and Mapping Industry in Canada was initiated and co-ordinated by the Canadian Institute of Surveying. The major portion of the funding for the study was provided by the Department of Regional Industrial Expansion, and some additional funding and other support was provided by the Canadian Institute of Surveying, the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Association of Hydrographic and Ocean Surveying Industries, the Canadian Hydrographers Association and the Canadian Cartographic Assocation.

1.2 Terms of Reference of the Task Force

The terms of reference of the Task Force are described in the contract with the Department of Supply and Services as follows:

Requirement:

To carry out a study of the surveying and mapping industry. The industry comprises land, aerial and marine survey firms. The aim of the study is to determine the industry's strengths and weaknesses, and to describe the domestic and international constraints and opportunities it faces.

Scope of Work:

The study shall include:

Perspective: describing several key aspects of the industry -- how it is structured, how it operates, its significance to the Canadian economy and its development to date. All types of surveying and mapping will be covered.

Prospects: describing the potential and growth of the market anticipated over the next decade by sector and the constraints and opportunities facing the industry.

Interactions: outlining and assessing the interaction among the players involved, namely the interface between government and industry, the pros and cons of a unified industry association and the potential for greater co-operation.

Issues: outlining key concerns present in the industry which will affect future performance, e.g. innovation, research and development, technology and education.

1.3 Study Methodology

The study methodology of the Task Force consisted of three basic elements as follows:

1.3.1 Development of a statistical base through the distribution of Questionnaire No. 1 to all practising surveying and mapping and related firms in Canada, Questionnaire No. 2 to all government agencies involved in surveying and mapping, and Questionnaire No. 3 to Crown corporations and large public companies with a direct or indirect interest in surveying and mapping.

1.3.2 The development of responses to the questions raised in the Task Force terms of reference through the solicitation of written briefs from members of the industry.

1.3.3 The search for ideas with respect to the future of the surveying and mapping industry in Canada through a series of interviews by Task Force members with individuals and groups across Canada.

1.4 Questionnaire Design

The Task Force sought to maximize the rate of return of the questionnaires by:

- keeping the design of the questionnaire as simple as possible while still fulfilling the objectives of the Task Force;
- maintaining the confidentiality of Questionnaire No. 1 by arranging for the completed questionnaire to be returned anonymously to an accounting firm for summary and analysis.

The three questionnaires were designed by members of the Task Force with assistance from the accounting firm, and prepared in both official languages of Canada.

1.5 Development of Mailing Lists

1.5.1 Questionnaire No. 1 - the mailing list of the surveying and mapping firms was compiled from the membership lists of the Canadian Institute of Surveying, the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Hydrographic Association, the Canadian Cartographic Association and from supplemental lists for each region supplied by members of the Task Force.

1.5.2 Questionnaire No. 2 - the mailing list of government agencies was established in consultation with the Surveys and Mapping Branch, Energy Mines and Resources Ottawa, the directors of surveys and mapping in each province, and from the personal knowledge of the Task Force members in each region of Canada.

1.5.3 Questionnaire No. 3 - the mailing list of crown corporations and large companies was developed largely by the Task Force members from their personal knowledge of each region.

1.5.4 Briefs - a general request for briefs was published in both official languages in the CIS Newsletter, and a specific request was sent to 371 individuals and organizations.

1.6 Coverage and Response to Questionnaires

1.6.1 Questionnaire No.1 - This was the first attempt ever made by the industry to develop a mailing list of all firms practising in all sectors of the broad field of surveying and mapping and related industries in Canada. The mailing list consisted of 1 139 names of firms.

Questionnaire No. 1 was distributed and completed in a way that ensured complete anonymity. The Task Force therefore does not have a record of the 162 firms (14 per cent) that responded to Questionnaire No. 1.

1.6.2 Questionnaire No. 2 - The mailing list of government agencies should be complete with respect to the major surveying and mapping agencies, but there are many agencies with a relatively small surveying and mapping component which were not included. The questionnaire was sent to 98 agencies. Of these, 56 (57 per cent) completed and returned the questionnaire (see Appendix 2 for list of respondents).

1.6.3 Questionnaire No. 3 - The Task Force experienced some difficulty in identifying those Crown corporations and large public companies which had a direct or indirect interest in surveying and mapping; while the list is representative it is probably not complete.

The original list consisted of 75 names, and 20 (27 per cent) responses were received (see Appendix 3 for list of respondents).

1.7 Briefs

To make it possible for the written briefs to be tabulated and correlated to some extent, the request for briefs outlined seven specific subjects which respondents were asked to address. There was also a general section to cover any other areas of concern. Forty-five briefs were received (see Appendix 4 for list of briefs).

1.8 Interviews

An interview questionnaire was designed with the objective of providing for some uniformity in the interview discussions. The purpose of the interview was primarily to search for new ideas with respect to the surveying and mapping industry, and also to confirm and expand some of the ideas put forward in the briefs.

Eighty-seven interviews were conducted with a wide cross-section of persons and organizations involved in the surveying and mapping industry from coast to coast. Included in the interviews were surveying and mapping firms, government agencies, educational institutions and a number of professional and technical associations. A complete list of those persons and organizations interviewed is attached as Appendix 5.

2. DESCRIPTION OF THE INDUSTRY

2.1 General Definition and Description

Surveying has been defined as the applied science of measuring the geometric and physical features of the environment, and mapping has been similarly defined as the applied science of representing those physical features on a flat surface in the form of maps and charts.

The surveying and mapping industry therefore encompasses, but is not limited to, land surveying, geodetic surveying, photogrammetry, hydrography, cartography, engineering surveying, mining surveying, remote sensing (including aerial photography) and some aspects of geophysical surveying. Spatial information systems are of primary interest to the surveying and mapping industry because they are in many respects computerized methods of gathering, storing and displaying the information which has traditionally been gathered, stored and displayed by surveyors and mappers.

2.2 Role of Surveying and Mapping Within Society

The surveying and mapping community in Canada is responsible for creating, maintaining and managing the network of basic surveying and mapping frameworks on which our whole society depends. The responsibilities are many, and they include but are not limited to the following:

- to create and maintain the land surveys which are the very basis of the land tenure system, and subsequently all the other infrastructure related to land;

- to provide the total geodetic survey system on which society depends for the determination of accurate positions of features of the environment;

- to provide maps and charts and surveying expertise for purposes of:
    - navigation on land, sea and air,
    - land use planning and urban developments,
    - planning the development of natural resources,
    - design and construction of all engineering works,
    - national defence,
    - the planning, development and maintenance of transportation networks,
    - providing the infrastructure required for the development and utilization of spatial information systems.

2.3 Land Surveying

Land surveying may be defined as the measuring, admeasuring, delineating, describing, marking, and/or monumentation of interests in land and real property, together with the recording, graphic representation and registration of the same.

The principal clients for different types of land surveys are as follows:

Subdivision surveys - land developers and land owners;
Right of way surveys - hydro companies, oil and gas pipeline companies, railway companies;
Road surveys - municipal and provincial governments;
Well site surveys - oil and gas exploration companies;
Building location surveys - lawyers, financial institutions;
Site surveys - architects, construction companies;
Retracement surveys - individual land owners.

2.4 Geodetic Surveying

Geodetic surveying is the discipline that deals with the measurement and representation of the earth, including its gravity field, in a three-dimensional time varying space.

Geodetic surveys are primarily required by the federal, provincial and municipal governments.

2.5 Photogrammetry

Photogrammetry is the art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring and interpreting images and patterns of electromagnetic radiant energy and phenomena.

The primary domestic clients for photogrammetry are the federal, provincial and municipal governments in the production of maps. The foreign market clients are national and international aid agencies and foreign governments.

2.6 Hydrography

Hydrography is the science of measuring and depicting those parameters necessary to describe the precise nature and configuration of the seabed, its geographical relationship to the landmass, and the characteristics and dynamics of the sea.

The primary domestic clients for hydrographic surveys are the federal and provincial governments. In the private sector, the oil and gas exploration companies working offshore are becoming major clients for hydrographic surveys in both the domestic and foreign markets.

2.7 Cartography

Cartography is the art, science and technology of making maps and related products.

The primary clients for cartography are the federal, provincial and municipal governments.

2.8 Spatial Information Management

Spatial information management includes the development and administration of geographic information systems in the land, marine and space environments, and the analysis and presentation of spatial information.

The term "spatial information" is used throughout this report because of its growing recognition, and because it is less restrictive than other widely used terms such as geographic information, land information and land related information.

Governments and utility and resource companies in both the domestic and foreign markets are the major clients for spatial information management.

2.9 Engineering Surveying

Engineering surveying is carried out (i) to provide horizontal and vertical control for the design and development of man-made structures, (ii) to provide for the staking out and construction of these structures, and (iii) to provide for the monitoring of the stability of the structures and their environment.

Engineering surveys are required for all construction and development projects. The major clients are land developers, construction companies, engineering firms, resource development companies, hydro companies, etc.

2.10 Mining Surveying

Mining surveying is carried out for (i) establishing of horizontal and vertical control for the design and development of underground and surface mines, and any other underground excavations, (ii) staking out and mapping of underground and surface mines, and any other underground excavations, and (iii) monitoring of ground stability (deformations), both underground and surface, in connection with mining activity and with extraction of any solids, fluids or gas from underground.

The principal clients for mining surveys are the developers of both open pit and underground mines.

2.11 Remote Sensing

Remote sensing is the detection, identification and evaluation of objects and phenomena by aerial sensing devices.

Remote sensing clients to date have been primarily various federal and provincial government agencies - especially those responsible for monitoring large scale changes in our physical environment. As the resolution capabilities of remote sensing techniques improve, there is an increasing utilization in private sector areas such as mineral exploration and large scale development projects.

2.12 Geophysical Surveying

Geophysical surveying is carried out for the positioning of the sub-surface physical resources of the earth and the preparation of associated maps and charts.

The oil and gas and mineral exploration companies and governments are the primary clients for geophysical surveys.

3. SURVEYING AND MAPPING ORGANIZATIONS

3.1 The Canadian Institute of Surveying (CIS)

Objectives:

1. To promote professional interest in the broad field of surveying and mapping including but not limited to cartography, control surveys, engineering surveys, geodesy, hydrography, land surveys, mine surveys, photogrammetry, remote sensing and photo interpretation, and to enhance the usefulness of these professions to the public.

2. To encourage and assist the advancement of and research in all the related professions connected with surveying and mapping.

3. To co-operate with, promote good relations amongst and assist in the exchange of information between members of similar and related organizations both nationally and internationally.

4. To further the professional, social and economic welfare of its members.

5. To promote and further the profession of surveying and mapping.

Membership: 2 500

3.2 Canadian Council of Land Surveyors (CCLS)

Objectives:

1. To promote and advance the science and art of land surveying and the knowledge of land surveyors in connection with the practice of the profession of land surveying.

2. To promote a common standard of professional ethics among land surveyors.

3. To promote common educational and technical standards for land surveyors.

4. To promote the reciprocal recognition by the governing bodies of land surveyors in each province of the professional qualifications of land surveyors from other provinces.

5. To hold meetings for the discussion of land surveying problems and the exchange of views in matters relating to land surveying.

6. To do all other things as are incidental or conducive to the attainment of the above objects.

Membership: The provincial land surveyors associations and corporations representing 2 700 land surveyors.

3.3 Canada Lands Surveyors (CLS) Professional Affairs Committee

Objectives:

1. To further the professional, social and economic welfare of Canada lands surveyors.

2. To provide a forum in which Canada lands surveyors may jointly or individually make known their views and wishes regarding their professional, social and economic welfare.

3. To encourage and assist educational advancement among Canada lands surveyors and make recommendations to the Board of Examiners.

4. To promote good relations among and assist in the exchange of information between Canada lands surveyors.

5. To assist in maintaining high professional standards and conduct by Canada lands surveyors.

6. To consider the qualifying requirements and standards (academic and practical) on a continuing basis and make recommendations to the Board of Examiners.

Membership: 212

3.4 Canadian Association of Aerial Surveyors (CAAS)

Objectives:

1. To promote the science of aerial surveying and the knowledge of members in connection with the practice of aerial surveying.

2. To encourage the establishment of high standards of workmanship with respect to aerial surveying.

3. To promote an ethical approach to business relations in the field of aerial surveying.

4. To promote the adoption by government of policies favourable to aerial surveying in Canada.

5. To establish and support or aid in the establishment and support of funds or trusts calculated to benefit aerial surveying in Canada.

6. To adopt such means for making known the objects and purposes of the association to the general public as may seem expedient.

7. To promote and engage in research in and development of the science of aerial surveying.

8. To do all such other things as are incidental or conducive to the attainment of the above objects.

Membership: 25 firms

3.5 Canadian Association of Hydrographic and Ocean Surveying Industries (CAHOSI)

Objectives:

1. To assist members in exploring and exploiting domestic and foreign markets for hydrographic and ocean surveys.

2. To obtain the support of government in acquiring and executing domestic and foreign contracts for hydrographic and ocean surveys.

3. To promote the adoption by government of policies favourable to the Canadian hydrographic and ocean surveying industry.

4. To increase international awareness of Canadian leadership in hydrographic and ocean surveying technology.

5. To encourage the establishment of high standards of ethics, workmanship and professional competence with respect to hydrographic and ocean surveying.

6. To adopt such means for making known the objects and purposes of CAHOSI to the general public as may seem expedient.

Membership: 13 firms

3.6 Canadian Hydrographers Association (CHA)

Objectives:

1. To advance the technical and professional ability of hydrographers by:

a) encouraging members to acquire a comprehensive knowledge of hydrography by a continuing program of study and development,

b) maintaining high standards of work,

c) fostering a critical interest in hydrography,

d) encouraging interest in the work of related organizations and disciplines.

2. To encourage a spirit of cooperation, tolerance, understanding and equality amongst all members in order that unity of purpose throughout the association can be established and maintained.

3. To promote the free exchange of information and ideas in order to keep members better informed and generally to establish and maintain lines of communication between branches.

Membership: 300

3.7 Canadian Cartographic Association (CCA)

Objectives:

1. To promote interest in maps and related cartographic material.

2. To further the understanding and knowledge of maps by encouraging research in the field of cartography, both historical and current.

3. To provide for the exchange of ideas and information, and for the discussion of mutual concerns, through meetings and publications.

4. To advance education in cartography and in the use of maps.

Membership: 400

3.8 Provincial Land Surveyors Associations and Corporations

The Constitution Acts 1867 to 1982 establish provincial jurisdiction with respect to the legislation dealing with the professions in Canada. Each of the 10 provinces in Canada has therefore enacted a Land Surveyors Act which makes provision for the establishment and regulation of the land surveying profession.

The general objectives of the Land Surveyors Associations and Corporations are:

1. To regulate the practice of professional land surveying and to govern the profession in accordance with the Land Surveyors Act, the regulations and the bylaws;

2. To establish and maintain standards of knowledge and skill among their members;

3. To establish and maintain standards of professional ethics among their members in order that the public interest may be served and protected.

The 10 provincial Land Surveyors Associations or Corporations and their membership are as follows:

Corporation of Land Surveyors of the Province of British Columbia	- 292 members
Alberta Land Surveyors Association	- 300 members
Saskatchewan Land Surveyors Assocation	- 100 members
Association of Manitoba Land Surveyors	- 73 members
Association of Ontario Land Surveyors	- 716 members
Ordre des Arpenteurs-Géomètres du Québec	- 845 members
Association of New Brunswick Land Surveyors	- 116 members
Association of Nova Scotia Land Surveyors	- 295 members
Association of Prince Edward Island Land Surveyors	- 18 members
Association of Newfoundland Land Surveyors	- 110 members

3.9 Associations of Survey Technicians and Technologists

The survey technicians and technologists have established associations in some provinces but not in others. Membership in these associations is voluntary and they have been established with the objectives of introducing criteria for the certification of technicians and technologists, establishing educational standards, and gaining some degree of official recognition for survey technicians and technologists.

The associations of survey technicians and technologists are as follows:

- The Canadian Association of Certified Survey Technicians and Technologists (CACSTT) - this is an umbrella group similar to the Canadian Council of Land Surveyors. The membership consists of the following six provincial associations and societies:

  - Alberta Society of Survey Technicians and Technologists (ASSTT)

  - Saskatchewan Association of Certified Survey Technicians and Technologists (SACSTT)

  - Manitoba Association of Survey Technicians and Technologists (MASTT)

  - Association of Certified Survey Technicians and Technologists of Ontario (ACSTTO)

  - New Brunswick Association of Certified Survey Technicians and Technologists (NBACSTT)

  - The Society of Certified Survey Technicians and Technologists of Nova Scotia (SCSTTNS)

The survey technicians and technologists in the remaining provinces are represented by other groups as follows:

- British Columbia - survey technicians and technologists are registered with the Society of Engineering Technologists of British Columbia.

- Quebec - the survey technicians and technologists in Quebec are certified and registered by the Order of Applied Sciences Technologists of Quebec.

- Newfoundland - the survey technicians and technologists are represented by the Association of Engineering Technicians and Technologists of Newfoundland.

- Prince Edward Island - the survey technicians and technologists are not formally represented by any organization.

- Yukon and Northwest Territories - the survey technicians and technologists are members of the Alberta Society of Survey Technicians and Technologists.

3.10 International Societies

The aims of the various international societies in the broad field of surveying and mapping are essentially the advancement of the technical aspects of their disciplines through the holding of international congresses, symposia and work group sessions.

The Canadian surveying and mapping community is represented at the international level by the Canadian Institute of Surveying which is the member association of:

- International Federation of Surveyors (FIG)
- International Society for Photogrammetry and Remote Sensing (ISPRS)
- International Cartographic Association (ICA)
- Commonwealth Association of Surveying and Land Economy (CASLE)
- International Society for Mine Surveying (ISMS)
- International Association of Geodesy (IAG)

4. CURRENT STATUS OF THE INDUSTRY

4.1 Number of Firms

There is no current list or directory of all the private surveying and mapping firms in Canada, and therefore the Task Force undertook the preparation of such a list. A total of 1 139 surveying and mapping firms were identified.

4.2 Employment by Sector

The Task Force members have made an estimate of the total number of persons employed in the industry by region as follows:

Atlantic Provinces	550
Quebec	1 500
Ontario	3 000
Prairie Provinces	2 150
British Columbia	1 750
Yukon and N.W.T.	50
Total	9 000

There is no clear breakdown available of the numbers of persons employed in each sector of the industry. However, an analysis of the responses to Questionnaire No. 1 indicates that the percentage of persons employed in each sector is as shown in Chart 1. This chart represents the primary occupation of the respondents.

4.3 Importance of the Industry to the Economy

An analysis of the results of Questionnaire No. 1 indicates that for the period 1979 through 1983, each employee in the industry generated, on the average, gross revenues of $38 000. Assuming that there are 9 000 persons employed in the industry (see Section 4.2), this would indicate total industry revenues of approximately $340 000 000 per year in Canada.

Canada has long been a world leader in the export of surveying and mapping services, and the total value of export is presently estimated to be from $50 000 000 to $60 000 000 per year. This amount would be included in the total of $340 000 000.

The respondents to Questionnaire No. 1 reported gross sales for the years 1979 to 1983 inclusive. Adjusting the values of the reported gross sales to 1983 dollars, there was a drop in gross revenues of 24.9 per cent from 1981 to 1983. The yearly percentage change in gross revenues for the reporting firms is illustrated in Chart 2.

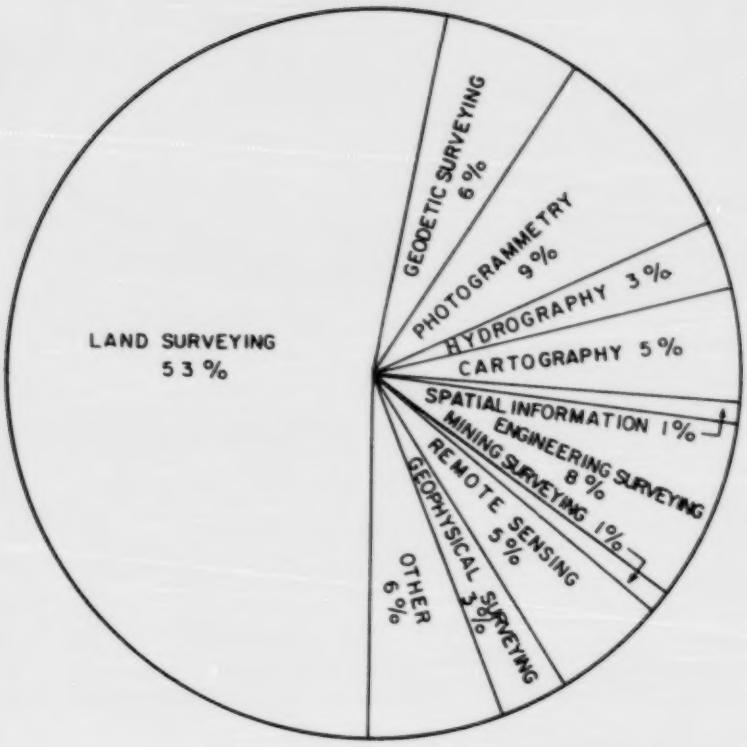

CHART 1.

Ratio of personnel employed in each sector of the Surveying and Mapping Industry as reported in Questionnaire No. 1.

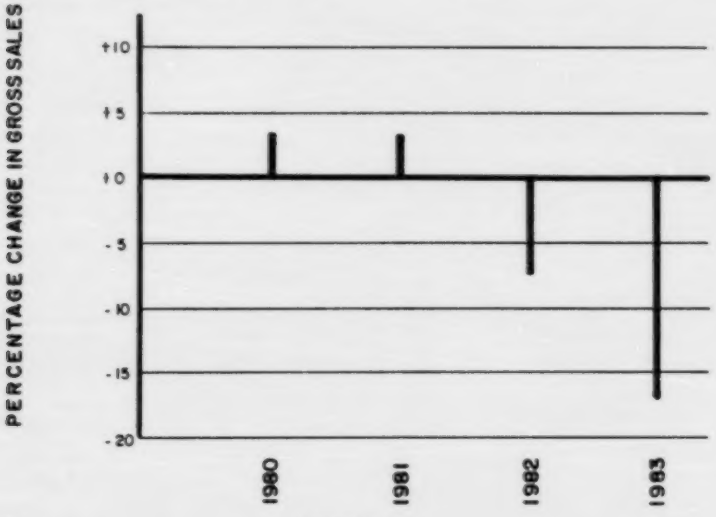

CHART 2.

Percentage yearly change in gross sales (1983 dollars) for firms responding to Questionnaire No. 1.

5. OWNERSHIP AND INDUSTRY STRUCTURE

5.1 Number and Size of Firms, Distribution and Ownership

In the development of the mailing list for Questionnaire No. 1 the Task Force determined that there are 1 139 surveying and mapping firms in Canada, and that they are distributed as shown in Table 1 below. The table also shows the total population for each region and indicates that the firms are not concentrated in any one region of Canada, but distributed more or less evenly in proportion to the populations of the regions. The exception to this is that there is a larger number of firms per 100 000 population in British Columbia and the Yukon and Northwest Territories.

TABLE 1.

Distribution of Surveying and Mapping Firms

	Number of Surveying and Mapping Firms	Percentage of Surveying & Mapping Firms in Each Region	Statistics Canada Estimated Population for June/84	Surveying and Mapping Firms per 100 000 Population
Atlantic Region	101	8.9	2 288 000	4.4
Quebec	296	26.0	6 549 000	4.5
Ontario	363	31.9	8 937 400	4.1
Prairie Region	197	17.3	4 411 500	4.5
British Columbia	177	15.5	2 870 800	6.2
Yukon and N.W.T.	5	0.4	71 200	7.0
	1 139	100.0	25 127 900	4.5

The ownership of surveying and mapping firms in Canada is virtually one hundred per cent Canadian. Most firms are owned by individuals who have made a career of surveying and mapping, and three or four of the larger firms have a public share structure.

The size of surveying and mapping firms ranges from sole proprietorship with one or two employees to large integrated firms with up to 200 employees. The amount of annual gross sales of firms responding to Questionnaire No. 1 is illustrated in Chart 3 which shows that 80 per cent of firms have gross annual sales of less than $500 000. This percentage is probably true for the whole surveying and mapping industry, and the Task Force estimates that no more than 10 firms have gross sales in excess of $3 000 000 per year.

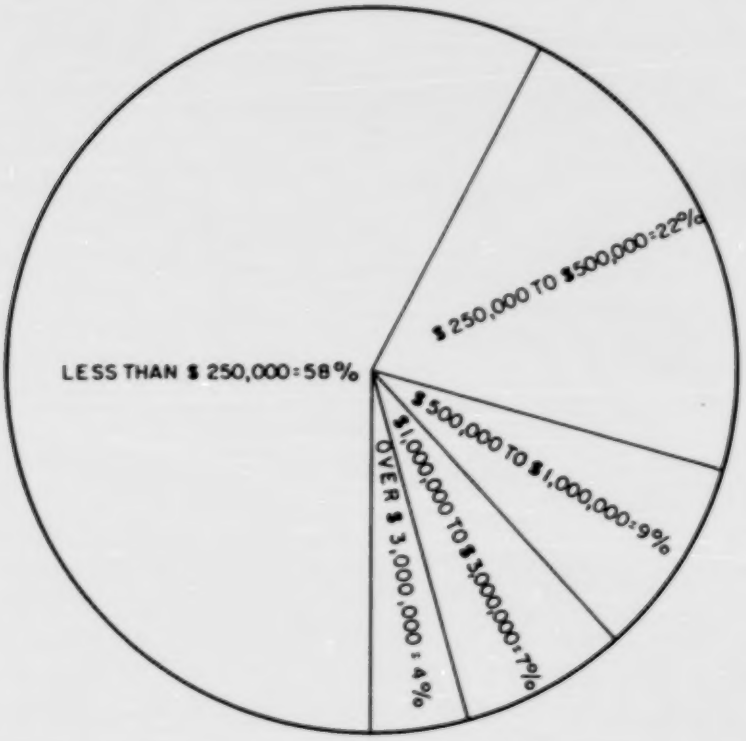

CHART 3.

Annual Gross Sales of Firms Responding
to Questionnaire No. 1.

5.2 Services Provided by Firms

The large integrated surveying and mapping companies offer a full range of services including land, geodetic, hydrographic, engineering, mining and geophysical surveys together with photogrammetry, spatial information management and remote sensing. Some firms offer only photogrammetry, or land surveys, or hydrographic surveys, but the majority of firms offer a range of surveying and mapping services, within their technical capabilities. The trend in recent years has been for experts in the various fields of surveying and mapping to come together in integrated companies to make it possible to offer a complete surveying and mapping service. This is almost a necessity for those companies which undertake large surveying and mapping contracts where many different techniques and methodologies are required for different aspects of the same contract. This is particularly true in the case of many foreign contracts, in which proposals are invited for a complete surveying and mapping service.

The range of services offered by the firms responding to Questionnaire No. 1 is illustrated in Chart 4. Land surveys are carried out by a large majority of firms (81 per cent), and at the other end of the spectrum only a very few firms are involved in hydrography, cartography, remote sensing and geophysical surveys. Photogrammetry and hydrography are capital intensive sectors of the industry, and consequently only the larger, well financed firms are capable of providing these services. The Canadian Association of Aerial Surveyors reports that 36 firms in Canada offer photogrammetric services. Similarly, the Study of the Canadian Hydrographic and Ocean Surveying Industries (1983) identifies approximately 29 firms which have hydrographic surveying capabilities.

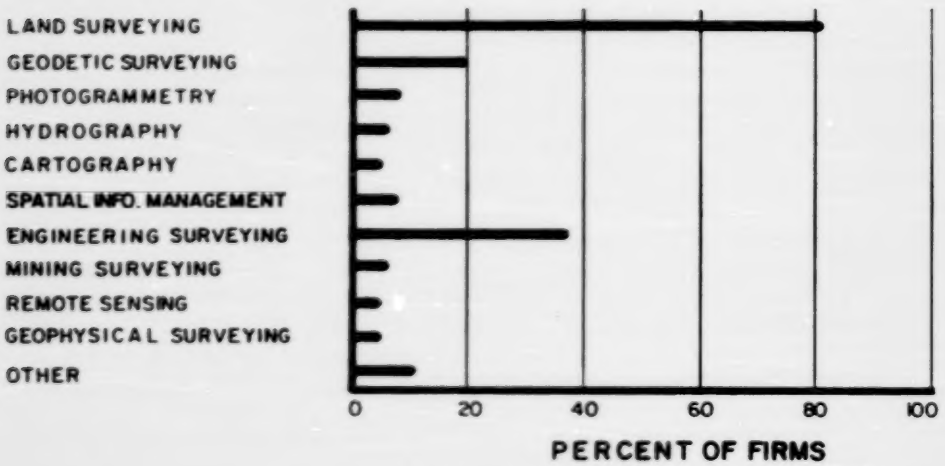

CHART 4.

Per cent of firms providing services in various disciplines by respondents to Questionnaire No. 1.

5.3 Regional Structure of the Industry

Table 1 (p. 19) was prepared from an analysis of the mailing list of the 1 139 surveying and mapping firms in Canada. The list was developed for the distribution of Questionnaire No. 1; and in order to prevent duplication the list included only head offices, and respondents were asked to complete only one questionnaire for each firm.

Although the questionnaire did not request data on branch offices, branch offices are generally opened in areas in which opportunities become evident because of new development and expansion. They are often temporary in nature and are moved or closed when the development stage of the area has been completed. Head offices are usually located in major population centres.

5.4 Relationship With Other Industry Sectors

The surveying and mapping industry is closely allied to and works extensively with many other industry sectors. Some examples of this relationship are as follows:

- Engineering - many firms whose primary role is engineering have a division which offers surveying and mapping services. Conversely, many surveying and mapping firms are engaged in engineering and others work extensively for engineering firms.

- Urban and Regional Planning - surveying and mapping firms are extensively involved in land use planning and subdivision design. At the same time they work with and provide surveying and mapping services to firms primarily engaged in planning.

- Geophysics - a few surveying and mapping firms have the capability to undertake geophysical surveys (especially airborne) but many provide surveying and mapping support for firms which are primarily geophysical exploration companies.

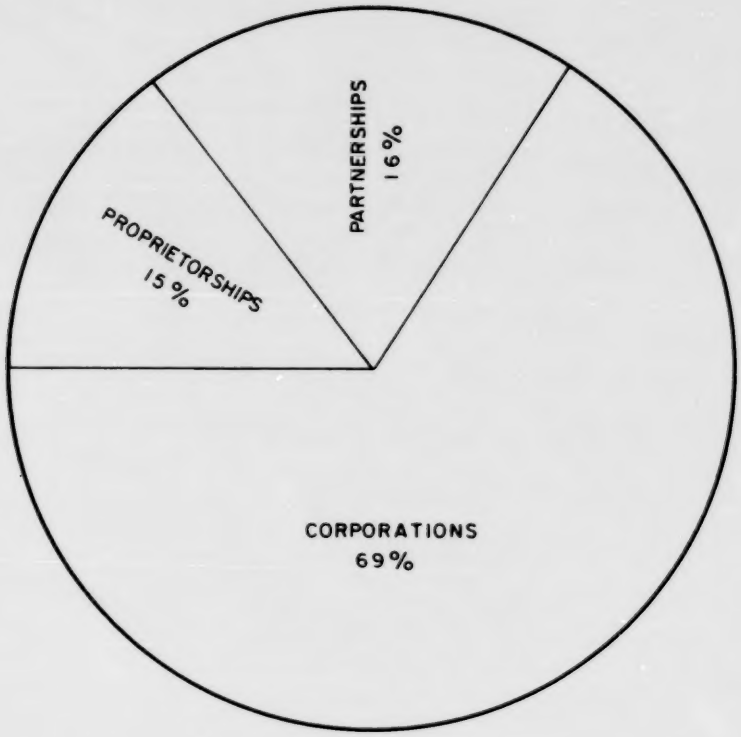

CHART 5.

Corporate structure of firms responding
to Questionnaire No. 1

5.5 Corporate Structure of Firms

The responses to Questionnaire No. 1 indicate that most surveying and mapping firms (69 per cent) are organized as corporations, as illustrated in Chart 5. The responses also show that the respondent firms with gross annual sales in excess of $500 000 are almost all (86 per cent) set up as corporations, while most of the partnerships and sole proprietorships (90 per cent) are in the group with gross annual sales of less than $500 000.

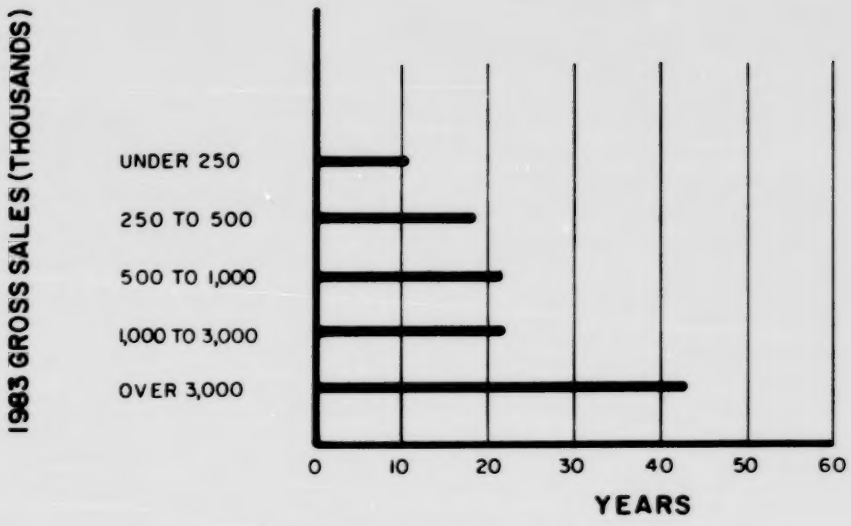

CHART 6.

Average years in business by gross sales for respondents to Questionnaire No. 1.

5.6 Average Years in Business

Chart 6 shows that for the firms responding to Questionnaire No. 1, the larger firms have been in business for a longer period of time. The Task Force believes that this would be generally true for the whole industry, with the exception that some relatively young firms which are more involved in space age technologies are growing rapidly and will soon rank among the largest firms.

6. DESCRIPTION OF MANAGEMENT AND EMPLOYEES

6.1 Management

Management of surveying and mapping firms is generally drawn from the professional and technical personnel. Most of the land surveying firms are managed by the land surveyors who own the firm. The photogrammetric companies and the large integrated surveying and mapping companies are managed by persons who are either the owners of the firm or who are long-time employees. The same pattern applies to virtually all surveying and mapping and related companies - management is drawn from professionally and technically qualified persons who in many instances are also the owners of the firm.

Some comments were received by the Task Force through the briefs and interviews to the effect that professional and technical people do not generally make good managers. The Task Force agrees that this may be true. However, it does not believe that surveying and mapping firms should be managed by professional administrators because, in a highly technical occupation such as surveying and mapping, effective managers need to have a thorough knowledge of the technical aspects of the industry. The Task Force does believe however, that the management of most surveying and mapping firms could benefit from some formal instruction in business management practices.

Recommendation 1:

> That surveying and mapping firms should provide opportunities for management personnel to attend courses on business management.

6.2 Employees

Charts 7 and 8 illustrate some of the characteristics of the employees of the firms that responded to Questionnaire No. 1.

Chart 7 shows the average percentage of technicians, professionals and administrative staff for the responding firms. The average ratio of technicians to professionals throughout all sectors of the industry is 2.5 to 1. However, the ratios vary substantially from a low of 0.6 to 1 for remote sensing to a high of 5.5 to 1 for photogrammetry.

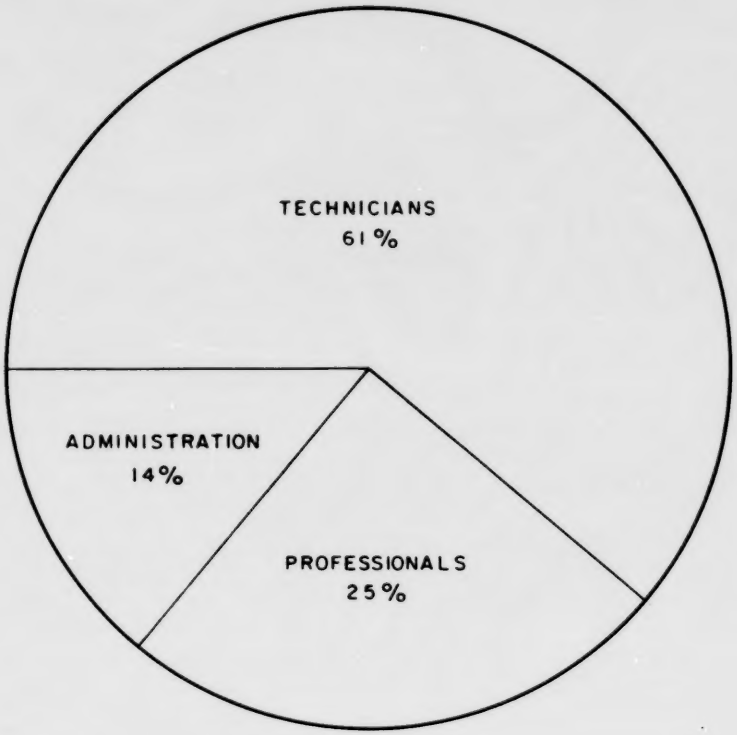

CHART 7.

Percentage of technical, professional and administrative personnel reported by respondents to Questionnaire No. 1.

The question for Chart 8 asked the respondents to list only the highest qualification for each person. The chart therefore indicates that of the employees of the responding firms, 21 per cent have a university degree, 29 per cent have a technician or technologist diploma, and 45 per cent list high school as their highest academic qualification.

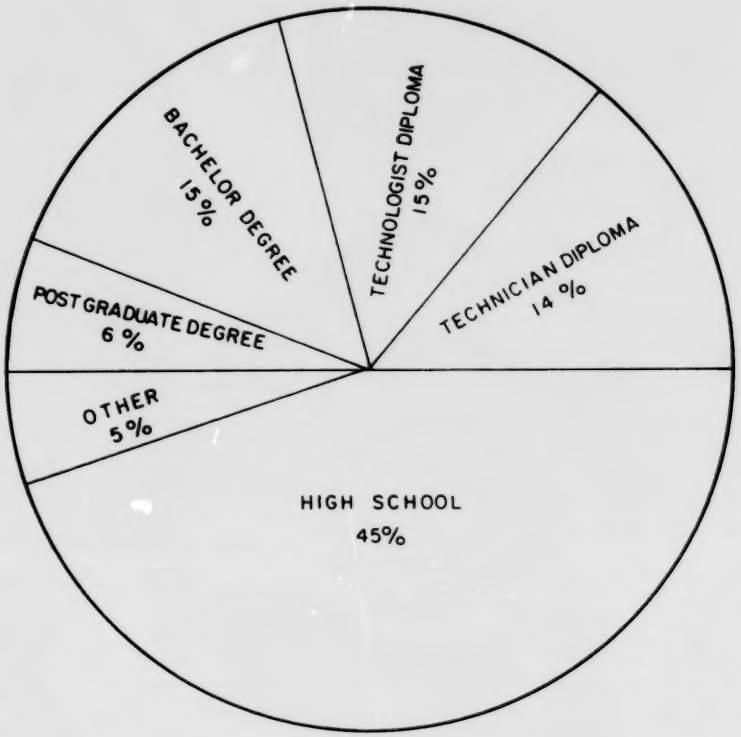

CHART 8.

Highest academic qualifications of personnel of firms responding to Questionnaire No. 1.

6.3 Professional Personnel

The majority of professional personnel of surveying and mapping firms are either professional land surveyors or professional engineers.

The largest single group within the industry is the professional land surveyors who are qualified to practise under the provisions of the provincial Land Surveyors Acts and the Canada Lands Surveys Act. Until recently most land surveyors became qualified through an articling and professional examination process. Now, however, the required route is first to acquire a university degree in survey science or surveying engineering or equivalent and then to write a limited professional exam and article to a practising surveyor for a year or two as may be required by provincial legislation.

The survey science and surveying engineering programs offered by Canadian universities are listed in Appendix 6 of this report.

6.4 Technical Personnel

The technical personnel of the surveying and mapping industry are drawn from a wide spectrum of backgrounds. Many have a high school education supplemented by on-the-job training. Increasing numbers are enrolling in the surveying and mapping programs offered by the technical institutes and CEGEPs listed in Appendix 6 of this report. Technical education at these institutions is usually supplemented by on-the-job experience in one or more of the specific surveying and mapping disciplines.

The skills required by technical personnel are somewhat different for each surveying and mapping discipline. Those involved in land surveys, geodetic surveys, engineering and mining surveys need to be thoroughly skilled in measurement techniques and in all methods of position determination. The technical personnel in photogrammetry, hydrography and geophysical surveys require mapping, cartographic and charting skills, and they must also be competent in position determination and in operating all the data capturing equipment.

Those involved in cartography, spatial information management and remote sensing need to have a knowledge of geographic referencing systems and map projections together with an ability to manipulate and manage data in digital format.

There is an increasingly urgent need for all those involved in the surveying and mapping industry to become more qualified in the use of computer systems.

7. EDUCATION

7.1 Professional Education

Canadian surveying and mapping education has a long and distinguished tradition. Historically, the professional surveyor in the common law provinces of Canada was educated in a university faculty of civil engineering or forestry, or was trained in the field through an apprenticeship program. Many entrants to the profession had a military survey education. The one exception to this approach is the province of Quebec, where the provincial legislature created a chair in land surveying at Laval University in March of 1907 and established l'École d'Arpentage the following year.

Following several years of growing concern about the quality of training for the profession, a national colloquium on surveying and mapping education was convened in Ottawa in 1959.

The dominant concern expressed at the colloquium was for the need to train surveyors capable of coping with the technological revolution in photogrammetry and geodetic and engineering surveying then underway. One of the outcomes of this first national colloquium was that several universities were encouraged to introduce or expand their offerings in surveying and mapping. Only one degree program was established, however, when in 1960, the University of New Brunswick established the first department of surveying engineering on the North American continent. This department was patterned after European degree programs in surveying, with considerable emphasis placed on advanced technical studies in photogrammetry and geodetic surveying, and on the mathematical tools required for computational analysis.

A second national colloquium was held in Ottawa in the autumn of 1966. This conference addressed the problem of attracting students into the surveying and mapping field (an extremely important concern at the time), the growing importance of the technical institutes, and the perceived need to inculcate a rigorous, scientific philosophy into the curriculum.

During the subsequent decade there was a considerable strengthening of the surveying and mapping curriculum in the sciences and mathematics subjects, with particular emphasis given to expanding the geodesy offerings. This direction was supported not only on pedagogical grounds, but also by an assessment of the potential graduate marketplace, for it was during this period that considerable activity was underway in constructing the provincial co-ordinate systems, in introducing the integrated survey area concept, and in applying sophisticated positioning techniques to the burgeoning resource exploration field.

More or less during the same period, the provincial land survey associations were beginning to assess the need to raise their professional qualifications standards to the degree level. But there was widespread concern within the profession about whether a largely science-oriented curriculum could accommodate their needs. Was the professional surveyor to be a measurement specialist only, or was he to reclaim the land information and land management function that the profession had exercised in the past and for which there once more seemed to be a demand? This question was partly addressed at the third colloquium on surveying education held in October 1977 at Lac Delage, Quebec.

The third colloquium represented an important milestone in the evolution of land survey education. Participants unanimously adopted a resolution supporting the concept of an expanded surveying profession, urged the Canadian Council of Land Surveyors to take a leadership role, and recommended that there be close co-operation within the university community - a community that, by the end of the 1970s, included not only Laval and the University of New Brunswick, but also programs in survey science at the University of Toronto and in surveying engineering at the University of Calgary. A number of other universities including Memorial, Carleton and Alberta, were also providing specialized training in cartography and remote sensing.

7.2 Technical Education

The first technical education for the surveying and mapping industry in Canada was provided by the Calgary Institute of Technology and Arts in 1920. Later, in 1945, the Nova Scotia Land Survey Institute was established. But apart from these two institutes there was little or no technical education available for the surveying and mapping industry until after the passing of the Federal Technical and Vocational Training Assistance Act in 1961. This act provided that the federal government would contribute 75 per cent of the provinces' approved capital expenditure for technical and vocational training facilities. The result of this Act was the establishment of a number of technical surveying and mapping programs across Canada. A list of those institutions which currently provide technical education programs for surveying and mapping is provided in Appendix 6 of this report.

The Second Colloquium on Survey Education in 1966 demonstrated a recognition of the need for more technical education for surveying and mapping, and resulted in the establishment of a special committee on the education and certification of survey technicians in Canada.

The Third Colloquium on Survey Education in 1977 was not so much concerned with the education of technicians as it was with the need for some form of official recognition for the survey technicians and technologists. This is still a matter of concern today and it is discussed further in Section 12.2 of this report.

One speaker at the third colloquium expressed concern that there were too many colleges providing survey options - especially in Ontario. The symposium on the surveying technologist in Toronto in 1982 reaffirmed this concern, and the briefs presented to the Task Force identified a problem with respect to the evaluation of the multitude of survey technician programs offered by colleges and institutes of technology.

The briefs to the Task Force expressed other concerns with respect to technical education for surveying and mapping:

- Programs should be expanded to include courses on spatial information systems.

- There should be more emphasis on the use of computers.

- Educators could be kept more up to date by being attached to government offices and/or field parties for limited periods of time.

- Technical colleges and institutes cannot teach everything in a two year course - institutes should specialize in one or two specific surveying and mapping disciplines.

- There should be more emphasis on the derivation of information for a wide variety of themes.

A full study of the educational opportunities for survey technicians and technologists is not within the scope of this study, but the concerns expressed to the Task Force reinforce the importance and need for the Fourth Colloquium on Surveying and Mapping Education at the University of New Brunswick in June 1985.

7.3 Curriculum Concerns

The intellectual foundation for the undergraduate program has traditionally been built upon the earth sciences and mathematics. It has been recognized that these courses give the students a language and approach to problem solving that is essential for their subsequent studies. Upon this foundation the student surveyor is expected to develop an understanding in some considerable depth of those technologies relevant to the discipline. While the curriculum continues to recognize the importance of such traditional subjects as surveying and photogrammetry, increasing attention is being given to such topics as remote rensing, digital mapping and so forth.

Beyond this scientific and technological base there has been a growing awareness of the importance of developing what might be described as a general systems approach to surveying and mapping. What has been lacking in the standard surveying curriculum until very recently has been an explicit examination of the evolving societal demands for land resource information, and of the role of the surveying profession in

responding to these demands. Increasingly, the surveying curricula are being expanded to include studies in the social sciences and law, and in economics and the management sciences. New courses in professional survey practice are also being introduced which bring together various concepts and themes related to the development and assessment of information technology, the design and management of information systems and the formulation of resource information policy. These themes are addressed at the Fourth Colloquium on Surveying and Mapping Education.

7.4 Technological Change

The accelerating rate of technological change presents an unprecedented challenge to those responsible for educating future surveyors and mappers. Perhaps a good goal for educational institutions at both the professional and technical levels would be to strive to produce graduates who are proficient in current surveying and mapping technologies, but who have sufficient basic knowledge to enable them to adapt quickly as the technologies change.

The Task Force recognizes that this goal is probably already the general thrust of professional and technical education programs. However, many schools do not have the financial or technical resources to adapt quickly to the requirements for technological change. Faculty retraining, replacement of obsolescent equipment and curriculum development are some of the areas where changes are difficult and slow.

A concern was also raised about the proliferation of academic programs, especially at the technical institute level. There is a need to concentrate limited human and technical resources to ensure that a certain critical mass can be achieved and comprehensive programs provided. This is an important concern which the Task Force believes the Canadian Institute of Surveying should take a lead role in addressing.

Recommendation 2:

> That government allocate supplementary funding to surveying and mapping educational programs to enable educational institutions to cope with rapidly changing technology.

Recommendation 3:

> That educational institutions make full use of advisory committees in the development of closer ties with industry with respect to (1) utilization of industry technical equipment and expertise on a part-time basis for educational purposes, and (2) the development of on-the-job training and experience for educators in government surveying and mapping agencies and in private firms.

7.5 Spatial Information Management

Spatial information management was stressed on numerous occasions by many leaders in the surveying and mapping industry as being the way to the future. There is a firm belief that all sectors of the industry, whether land surveying, photogrammetry, hydrography, geodetic surveying, remote sensing or cartography, will become involved in collecting, storing and using information in digital form, and that there is an urgent need for more education and leadership in this area by the educational institutions.

Recommendation 4:

> That educational institutions place greater emphasis on giving students a sound background in the development, management and utilization of information systems, and that curricula stress the integration of multiple sets of data into spatial information systems.

7.6 Communication Skills

Another major concern voiced by many respondents, both in the briefs and interviews, is the lack of communication skills, in both speech and writing, displayed by members of the surveying and mapping industry. The respondents clearly would like to see new graduates from both the professional and technical educational institutions better equipped to communicate effectively with others in our complex and technical society.

Recommendation 5:

> That educational institutions place greater emphasis on the development of communication skills at both professional and technical levels.

7.7 Multidisciplinary Approach

The structure of the relations between the various sectors of the surveying and mapping industry is changing. As recently as the 1940s and 1950s there were very clear lines of distinction between the disciplines of land surveying, geodetic surveying, photogrammetry and hydrography. However, in recent years those lines have become decidedly blurred to the point that all of the various disciplines in surveying and mapping are closely related and interdependent, especially at the technical level. There is therefore a need for educational institutions to recognize this, and to emphasize that a multi-disciplinary approach will be required for the effective provision of surveying and mapping services. It will no longer be adequate to be educated or trained in

one narrow aspect of surveying and mapping such as land surveys or hydrographic surveys or geodetic surveys. The surveyor, both professional and technical, will need a broad understanding of the basic principles of the new technologies such as satellite positioning, inertial surveying, digital data collection (by means of land surveying, photogrammetry and remote sensing), interactive graphics, automated cartography and data base management. At the same time, the surveyor will need to understand the underlying concepts of the various disciplines such as land surveying, photogrammetry, hydrography, geodetic surveying, remote sensing, etc.

Recommendation 6:

> That both the professional and technical curricula of educational institutions reflect the growing reality of a multi-disciplinary approach to surveying and mapping.

7.8 Applied Geography Dimension

Coupled with the technical aspects of the development, management and utilization of spatial information systems is a growing need for a change in the philosophy of surveying education which would recognize the evolution of the "applied geography dimension".

During the post-war period, and especially during the late 1950s and early 1960s, there were tremendous advances in technology associated with surveying and mapping, especially in photogrammetry and electronic distance measuring. This led to the development and/or revitalization of education courses to provide a strong engineering dimension to the surveying and mapping field.

In the late 1960s and early 1970s, more emphasis was given to the earth sciences (especially geodesy), mathematics and computer science in the academic programs. This second dimension was strengthened in large measure to provide a better scientific understanding of the technology and its application.

In the 1980s, with the growing importance of spatial information systems and information management, there is a need in the academic arena to give more emphasis to what might be called the applied geography dimension, especially in providing some understanding of what resource managers need in the way of information and in explaining how to disseminate and present this information effectively.

It is imperative that the surveying and mapping industry make the transition into the information age; an important first step will be a change in emphasis in education programs to reflect the applied geography dimension required by resource managers.

Recommendation 7:

That education programs for surveying and mapping be revised to give more emphasis to the applied geography dimension, especially in providing some understanding of the information needed by resource managers and explaining how effectively to disseminate and present this information effectively.

8. MARKET STRUCTURE

The basic market structure for the surveying and mapping firms responding to Questionnaire No. 1 is illustrated in Chart 9, which shows that in 1983 a total of 65 per cent of gross sales could be attributed to private sector clients, while 35 per cent was from various government sources. About 5 per cent of gross sales were in the export market and 95 per cent in the domestic market. The ratio of private sector sources to government sources appears to be a reasonable one. However, with respect to the export of surveying and mapping services, the Task Force in Section 4.3 of this report estimates gross annual sales to be about $340 000 000 with export sales estimated at $60 000 000 per year. This would indicate that foreign sales account for about 18 per cent of the gross sales of the surveying and mapping industry.

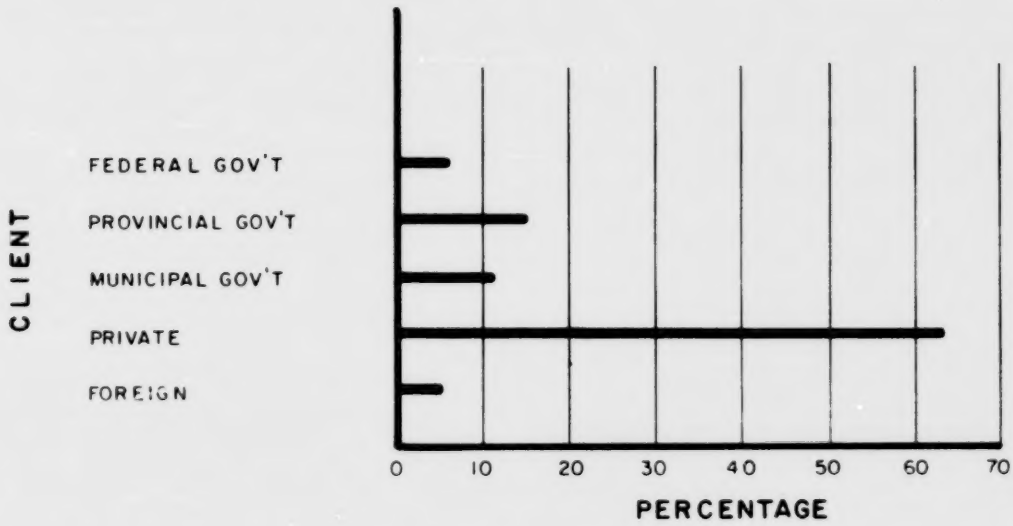

CHART 9.

Sources of gross 1983 sales reported by respondents to Questionnaire No. 1.

8.1 Domestic Market

The respondents to Questionnaire No. 1 indicated that in the surveying and mapping industry's domestic markets, private sector account for about 66 per cent of gross revenues, and the remaining 34 per cent come from federal, provincial and municipal governments. The private sector clients are primarily involved in some form of resource development, land development or major construction projects. These projects depend on the economic health of Canada, and therefore the surveying and mapping industry is also indirectly dependent on the economic situation. This has been clearly illustrated in the last five or six years. During

the latter part of the 1970s there was strong economic activity in Canada, and consequently the surveying and mapping industry was booming. The last three or four years have been the reverse - a severe economic recession meant a very much reduced volume of sales for the Surveying and Mapping Industry.

The 34 per cent of sales accounted for by various governments tends to be more stable and is generally not as severely affected by the state of the economy.

Chart 10 illustrates the distribution of gross domestic sales amongst the various surveying and mapping disciplines for the year 1983 as reported by the respondents to Questionnaire No. 1. Land surveys (45 per cent of gross sales) account for the largest portion of gross sales, while spatial information is the smallest at 1 per cent of the total. This could change substantially in the next decade or two. There is every indication that our society is becoming more stable, and that there will be less development and therefore less need for traditional surveying and mapping services. At the same time, there is an increasing demand for spatial information, and it is probable that domestic sales in this discipline will increase substantially.

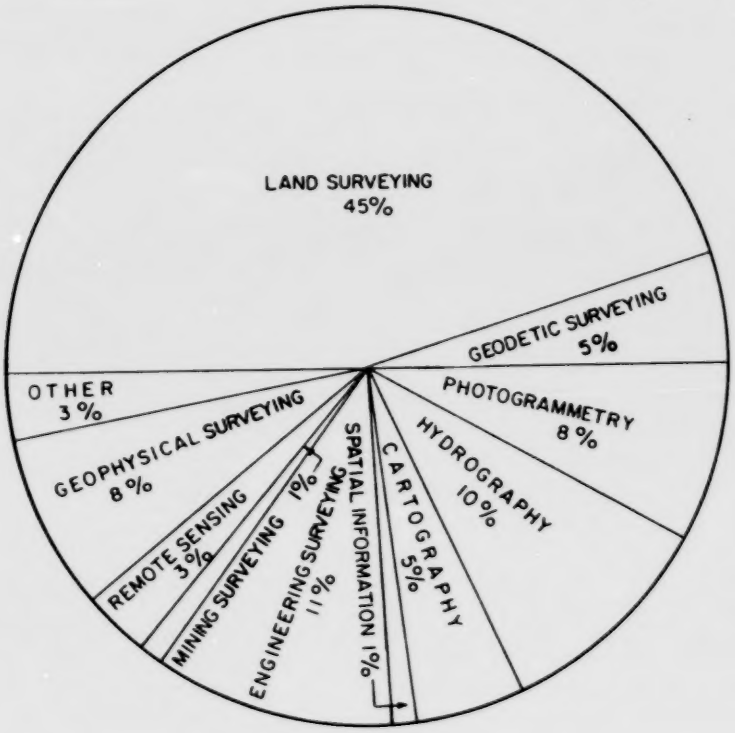

CHART 10.

Gross domestic sales by sector for 1983
(Questionnaire No. 1)

Hydrography is another discipline which is experiencing a period of growth. The 1983 CAHOSI study shows that in 1983 the domestic market for hydrographic surveys was $50 million from the private sector and $5 million from government. The same study predicts that the domestic market will improve substantially over the next few years depending on the volume of offshore resource development, and the volume of work contracted out by the federal government.

There is virtually no direct foreign competition for the surveying and mapping industry in the domestic market. However, several respondents to the Task Force expressed concern at the very substantial volume of surveying done by foreign firms involved in resource development. This applies primarily to foreign geophysical companies and oil companies involved in the development of offshore oil and gas. Most of these foreign companies have their own surveying and navigating capability and do not contract their surveying requirements out to Canadian surveying and mapping firms.

8.2 Foreign Market

Canada traditionally has excelled in providing surveying and mapping services in the foreign market. Services provided have included aerial photography and mapping, geodetic surveying, hydrographic surveys and charting, airborne geophysical surveys, and environmental and natural resource studies. More recently, the Canadian surveying and mapping industry has been responding to a need for expertise in spatial information management, satellite positioning and property mapping and land registration systems.

It is estimated that over the last five years the value of foreign projects undertaken by the Canadian surveying and mapping industry has averaged $50 million to $60 million annually. Some of the work is contracted for and paid for directly by foreign governments or by foreign resource development and construction firms. However, a substantial part of the foreign work is financed either by direct grants or loans from international financing and development agencies such as the Canadian International Development Agency, the Export Development Corporation, the World Bank, the United Nations Development Program, the International Development Bank, the Asian Development Bank and the African Development Bank.

The principal foreign markets for surveying and mapping services are currently in Southeast Asia, Africa, South America and the Middle East.

The main international competitors have been France, the U.S., the United Kingdom, Holland, West Germany and Japan. These have been joined more recently by Australia, Korea, Norway and Sweden.

The most important competitive factor is the bid or negotiated price, but there are others to be taken into account such as language, geographic location and proximity to the job site, political considerations, trade agreements, availability of financing and an understanding of local institutions. The governments of some countries such as Holland, France, Sweden and Norway are directly involved in seeking contracts, and the surveying and mapping firms from these countries are subsidized directly or indirectly by their governments.

Many of the developing nations now have a geodetic framework in place and much of the small scale mapping has been completed. It is therefore anticipated that there will be limited growth for these services. However, in other fields such as property mapping and spatial information management there is a rapidly expanding market. Hydrographic and other marine surveys is another area where there is increasing activity. The 1983 CAHOSI report estimates current foreign contracts of $5 million annually with the potential of increasing to $40 million.

9 FINANCIAL AND COST STRUCTURE

9.1 General Cost Structure

The surveying and mapping industry, like any other service industry, has the usual overhead such as office costs, stationery and supplies, automotive, reproduction, postage, telephone, insurance, etc. However, the two major factors are costs of technical equipment and payroll, both of which vary substantially from one industry sector to the other.

9.1.1 Cost of Technical Equipment

The capital cost of technical equipment required by the surveying and mapping industry has been rising at an alarming rate over the last five to 10 years. An analysis of the book value of surveying and mapping equipment for the firms which responded to Questionnaire No. 1, shows that the total book value increased from $12 million in 1979 to $22 million in 1983 (see Chart 11), an increase of 83 per cent. During the same period of time, the gross revenues for the same firms have risen from $73 million to $87 million (see Chart 12) an increase of only 19 per cent, which indicates a disproportionate increase in the capital cost of equipment.

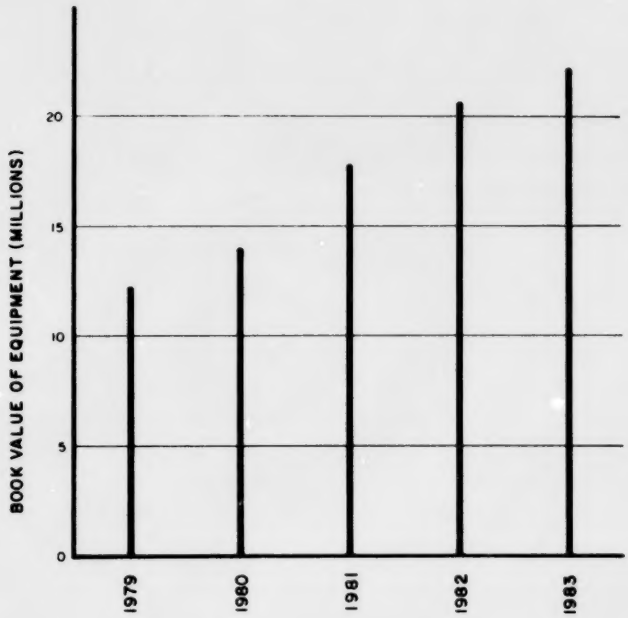

CHART 11.

Book value of equipment reported by respondents to Questionnaire No. 1.

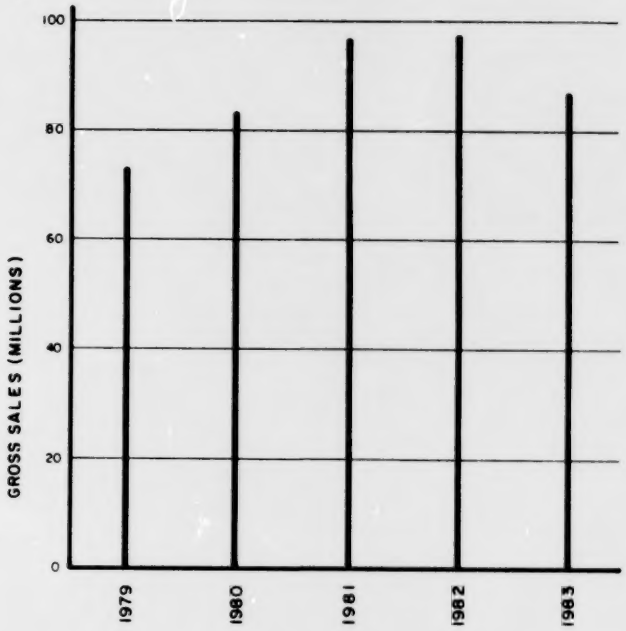

CHART 12.

Gross sales reported by respondents
to Questionnaire No. 1.

The cost of traditional surveying equipment has actually declined by about 34 per cent since 1981. This is attributed to very slow sales and a general trend towards the use of more sophisticated instruments.

The large increase in the book value of equipment illustrated in Chart 11 is due to the fact that the new technologies require the acquisition and utilization of high cost equipment such as satellite receivers, inertial surveying systems, digital plotters, computer systems, interactive graphics systems, etc. The cost of any one of these systems can range from $100 000 to $1 000 000 or more, compared to the costs of traditional surveying equipment such as a one-second theodolite, which costs about $6 000.

The charge out rates and the volume of revenue generated by this sophisticated equipment need to be at least sufficient to pay a 15 per cent or 20 per cent net rate of return on investment. At the same time it is necessary to pay the full capital cost over a period of no more than five years because within that period the equipment will most probably become outdated. For income tax purposes, most of the equipment is in Class 10 which allows an annual capital cost allowance of 30 per cent on a declining

balance. This alleviates the problem to some extent from an income tax standpoint, but the fact remains that financing costs are substantially higher than they were 10 years ago. The net result is that only the larger, well-financed firms are able to take full advantage of the new technologies.

9.1.2 Payroll Costs

There are no salary surveys available for the whole surveying and mapping industry. Some records are available from federal and provincial governments, and there are some partial records for industry in some of the regions. Chart 13 illustrates the percentage increase or decrease in salaries for some public sector and some industry personnel as compared with the Consumer Price Index. This is not a comprehensive study but it does indicate that salaries in industry have not kept pace with salaries in the public sector or with the Consumer Price Index.

Payroll Costs, including unemployment insurance, workers' compensation, medical and dental plans, pension plans, long-term disability insurance, etc., range from 20 per cent to 30 per cent of actual salary. The traditional charge out rate for personnel is two times the payroll costs, or 2.5 times the actual salaries of personnel. The reality is that in the competitive conditions which prevail at present it is unusual to be able to achieve these rates.

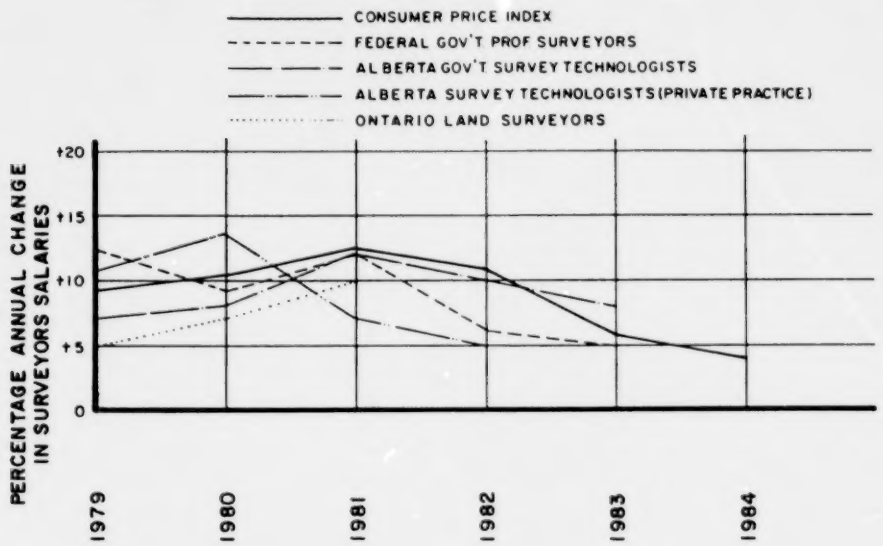

CHART 13

Comparison of salaries with Consumer Price Index

This method of determining charge out rates has been generally accepted by the industry and by governments and other clients as providing a reasonable rate of return.

9.2 Profitability

The respondents to Questionnaire No. 1 were not generally satisfied with the profitability of their firms in 1983. Those who reported that profitability was less than adequate range from a low of 34 per cent in the gross sales bracket of $250 000 to $500 000, to a high of 100 per cent for those with gross sales of over $3 000 000. The larger firms - those with gross annual sales in excess of $500 000 - seem to be less satisfied with profitability than the smaller firms. The Task Force attributes this to the fact that larger firms often have a relatively larger capital outlay in the more sophisticated mapping, charting and positioning equipment, and in greater computing capacity. The rate of return on the capital investment in equipment is generally considered to be inadequate.

The concern and general dissatisfaction with profitability is supported by the fact that several well-established mapping firms have ceased operations in the last two years.

An adequate level of profitability is a business decision for individual firms, but realistically the profit margin should reflect the substantial business risks inherent in the industry, the technical and professional expertise required, and the substantial investment in plant and equipment, accounts receivable and work in progress. A reasonable rate of return for surveying and mapping firms would be 10 per cent to 20 per cent of gross revenues after allowance for all costs and a provision for research and development, but in the last two or three years the rate of return has been generally most unsatisfactory.

This low rate of return results in major concerns for the industry. Perhaps most significant is the difficulty in attracting good people into the industry and the surveying and mapping education programs. It also means that industry has difficulty in financing new technical equipment and in house research and development. This in turn threatens Canada's competitive position in the export market.

9.3 Sources of Financing

While there are a few surveying and mapping or related companies with a public share structure which therefore have access to public financing, most are privately financed by the owners. Some of the larger firms, which require a large component of sophisticated technical equipment, depend substantially on bank credit. Many of the smaller firms are financed by owner's equity and cash flow and do not have a debt load.

The surveying and mapping industry is a service industry and treated as such by the commercial lending institutions. The usual yardstick for credit is about 50 per cent of current assets including equipment, accounts receivable and work in progress.

Financial assistance to firms involved in export is provided by some government agencies and programs such as the Export Development Corporation and the Program for Export Market Development (PEMD).

9.4 Financial Strength of the Industry

The lack of financial strength in the industry was a matter of concern for many who were interviewed by Task Force members. The surveying and mapping firms are caught in a financial squeeze between rapidly escalating costs of capital equipment (see section 9.1.1), increasing payroll costs (see section 9.1.2) and high interest rates, and at the same time the fees that they are able to charge are continually decreasing relative to the Consumer Price Index. The decrease in fees is brought about by the current weak economy in Canada, and by the increasing tendency of clients, especially governments, to call for bids on even the smallest survey and mapping projects, and then to award the contract primarily on the basis of price with little or no consideration for other factors such as technical capability or past performance. This subject is discussed at greater length in Section 11.1. Fairer and more equitable contracting out policies would substantially improve the opportunity for industry to maintain the financial strength which is needed to finance the highly sophisticated equipment required.

Although this discussion has dealt primarily with the domestic market, the same facts apply to foreign contracts - the profit margin is so small that it is becoming impossible to finance the equipment that is needed to remain competitive in foreign markets and to pay high enough salaries to attract the technically qualified and competent staff that are required.

The respondents to the Task Force generally were in agreement that the surveying and mapping industry needs to develop a financially and technically strong domestic base for effective competition in foreign markets.

10. TECHNOLOGY AND INNOVATION

The surveying and mapping disciplines in both the private and public sectors are experiencing the impact of technological change. Many of the traditional surveying, mapping and charting methods are being replaced by sophisticated new technologies. The problem for the industry is that in order to remain competitive in both the domestic and foreign markets there is a need not only to utilize the best technical equipment and expertise available, but also to continue to research and develop new technologies.

10.1 Research and Development

Canadians have a good record in innovativing and in researching and developing new surveying and mapping technologies. For instance, Canada has been a world leader in the development of photogrammetric and image analysis technologies and in the application of satellite positioning and inertial surveying systems. Canadians have also played a particularly important role in developing computer software for surveying and mapping programs (such as Schut's pioneering work on block adjustment packages) and for spatial information systems.

10.1.1 Government Research and Development Policies

Canada's record in providing funding for research and development in the natural and social sciences is not impressive compared with other industrial nations, as is illustrated by the statistics shown in Table 2 below.

Country	1981	1982
Canada	1.2	1.3
Finland	1.2	
France	2.0	2.1
West Germany	2.5	2.6
Italy		1.1
Japan	2.4	2.5
Sweden	2.2	
Switzerland	2.3	
United Kingdom	2.4	
U.S.A.	2.5	2.7

Table 2

Research and development in the natural and social sciences as a percentage of gross domestic product. (Statistics Canada)

Although Canada is experiencing a period of economic restraint, the provision of funds for research and development must be continued and increased if we are to remain competitive in world markets for surveying and mapping.

Recommendation 8:

That federal and provincial government funding for research and development in the field of surveying and mapping be increased to 5 per cent of surveying and mapping budgets.

Many respondents, in briefs and interviews, expressed concern over the lack of co-ordination of research and development programs and in the establishment of priorities in research. There is a definite need for a national group or agency to take on this responsibility, and the Task Force believes that this could be done most effectively by having the National Research Council establish a standing committee with representation from governments, industry and education. The committee would be responsible for the identification of research and development priorities and for the co-ordination of research programs.

Recommendation 9:

That the National Research Council establish a standing committee on research and development in surveying and mapping with representation from governments, industry and education. The committee would be responsible for the identification of research and development priorities, for the co-ordination of research programs and for the development of standards for surveying and mapping and spatial information systems.

10.1.2 Research Priorities

A brief submitted to the Task Force by the Head, Photogrammetric Research, Division of Physics, National Research Council of Canada, sets out in some detail a number of research priorities in the field of photogrammetry. The brief explains that as a result of "innovations brought about by implementation of the data base concept", aerial survey companies are having to deal with "problems related to the reorganization of production, restructuring of processing systems and retraining of the staff". The brief goes on to say that "the developments in this direction have only started and future improvement innovations related to the advances in parallel processing, machine intelligence and expert systems may be expected".

Other developments anticipated are the need for processing imagery (mono and stereo) from space platforms, development of the system software for the integration of photogrammetric

digital image metrology systems, and real time digital photogrammetry based on solid-state cameras for monitoring and controlling of dynamic processes.

The respondents to the Task Force requests identified a significant number of research priorities, but the single priority emphasized by most was the immediate need for more research in all phases of spatial information systems, including, but not be limited to, technology development and the acquisition, processing, storage and distribution of information. The research and development should be from an overall systems standpoint.

Other research priorities put forward by Task Force respondents were as follows:

- Application of the capabilities of global positioning systems;

- Refinement of procedures for inertial surveying in support of large scale mapping;

- Application of interactive graphics to survey projects (design and analysis phases);

- Development of improved survey markers for difficult terrain conditions;

- Development of software for contour compilation from digital terrain models;

- Data base management systems for computerized spatial information;

- Assessment of positioning systems with respect to operation, accuracies and cost;

- Standardization of computer formats;

- Precise navigation for aerial photography;

- Precise survey navigation using global positioning systems;

- Methodology for effecting an improvement in the elapsed time required for cadastral mapping;

- Digital terrain modelling;

- Digital imagery analysis;

- Elevation measurement systems;

- Electronic collection of field data;
- Dynamically controlled airborne systems;
- Integration of multiple sets of digital data;
- Second generation computer mapping;
- Development of expert systems;
- Pattern recognition studies;
- Development of tools and techniques for deformation measurement.

The above research and development topics are random suggestions taken from the briefs and interviews. The Task Force believes that rapidly changing technologies have created a need to explore the requirements more fully by way of a national symposium or conference. The last national conference on Research and Development Requirements in Surveys and Mapping was held in 1979; it was sponsored by the National Advisory Committee on Control Surveys and Mapping.

Recommendation 10:

That a conference on research and development strategies for surveying and mapping be initiated and organized by the Canadian Institute of Surveying with participation by other organizations such as the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Association of Hydrographic and Ocean Surveying Industries, the Canadian Hydrographers Association, the Canadian Cartographic Assocation, the National Advisory Committee on Control Surveys and Mapping, the universities and all government and private surveying and mapping research agencies.

10.2 Transfer of New Technology

The major obstacle to the early transfer of new technology is the high capital cost associated with technical innovation. Coupled with this is the strong likelihood of major cost reductions and technical improvements and refinements within a relatively short period of time. The rapid pace of technological change means that most technical equipment is superseded by cheaper and better equipment in a period of five years or less, and industry is faced with a continuing problem of financing new capital equipment.

The problem for the industry is to generate enough revenue out of a specific piece of equipment to pay the carrying charges and at the same time recover the capital cost in a period of five years or less. This is discussed in more detail in Section 9.1.1.

Perhaps one of the most effective methods of transferring new technology is moving knowledgeable people from one sector to another. For instance, researchers who have developed new techniques or new software at a research laboratory or at a university could be loaned to government or industry for a period of time to transfer their new ideas. This concept was supported in a recent address by Stuart Smith, chairman of the Science Council of Canada, in which he said, "I agree with those who say that people are the best thing to transfer. I would like to see a program whereby some government labs actually offer their people to industry for periods of time. Let them take their ideas with them and let them work on them in the industry's lab. The government could pay a good portion of the salary and it would still be cheaper in the long run."

Recommendation 11:

> That governments, universities and industry, co-ordinated by the Canadian Institute of Surveying, jointly develop a strategy whereby the transfer of new technology could be achieved by moving people from one sector to another. The development of this strategy could be discussed at the proposed conference on research and development strategies (see Recommendation 10).

10.3 Dependence on Foreign Technology

The surveying and mapping industry is heavily dependent on foreign technology. The traditional surveying and mapping optical instruments used by Canadians, such as theodolites, levels, stereoplotters, digitizers, cameras, etc. are manufactured primarily in Europe, the U.S. and Japan. Equipment such as inertial systems, satellite receivers, acoustic positioning systems, radio navigation systems, computer systems, etc., is manufactured in the U.S. Much of the software for these systems is American, but there is a very significant amount of software development in Canada.

The possibility of developing a hardware manufacturing industry in Canada was discussed by a number of the persons interviewed. The rationale is that Canada already has an aggressive and progressive surveying and mapping industry both in Canada and in the export market, and that there would be a substantial domestic market for hardware but this would need to be augmented by an aggressive export market program. The question of a distribution and servicing network would also need to be addressed. The development of such an industry would require large amounts of capital, dedicated research and development programs, and a concerted team approach by government, industry and research

organizations. Possibilities for the development of a hardware manufacturing industry, especially as it relates to research and development, could be discussed at the proposed conference on research and development (see Recommendation 10)

10.4 Impact of Technology on the Industry

All sectors of the surveying and mapping industry have been affected by the introduction of space age technologies. Perhaps the first major change was the introduction of radar systems such as Shoran and Hiran, which were used for mapping control in the northern regions of Canada immediately following World War II. These were followed quickly by electronic distance measuring systems such as geodimeter and telluro-meter. These systems have now been improved to the point where they are used to measure virtually all distances in excess of a few metres and up to about 10 km, beyond which other technologies come into play. The "total station", with both distance and angle measuring capability combined with the "electronic field book" system of recording field data in digital form ready for direct input to a computer, is now used extensively.

There is no doubt that computers have had a major impact on the philosophy and design of surveying and mapping systems in Canada. The mapping industry has undergone phenomenal changes from the early stereo plotters to the sophisticated digital plotters that produce topographic detail in digital files. The field of cartography is also undergoing changes with the introduction of interactive graphics and digital cartography.

The introduction of satellite Doppler systems in the late 1960s was perhaps the most far-reaching innovation of all, because it introduced the concept of direct three-dimensional positioning at any point on the surface of the earth without reference to any other known point. These systems have been developed to the point that a high degree of positional accuracy can be efficiently achieved, and the traditional methods of bearing and distance measurement for position determination are rapidly becoming obsolete for major survey projects.

Remote sensing (excluding aerial photography for photogrammetry) is being accepted slowly, though widely, as a source of thematic information by the surveying and mapping industry. Despite current uncertainties, a number of cost-effective applications have been developed from the use of satellite data for mapping at medium to small scales. In particular, simple non-digital techniques are being used with Landsat MSS images to accurately revise the thematic content of 1:250 000 topographic maps and to detect changes on 1:50 000 maps. Significant cost benefits have been achieved relative to previous methods. The next generation of remote sensors will provide data with higher resolution and greater selectivity. However, their practical use in thematic mapping will depend on the development of new technologies

to process the rapidly expanding volume of data economically and to extract the desired thematic information accurately.

The above are just a few examples of the technological change that the industry is experiencing. However, the Task Force believes that the introduction of spatial information systems heralds the most basic and far-reaching change of all, and that the surveying and mapping industry will need to adjust to a totally new concept of the traditional gathering, storing and disseminating of information about our physical environment. This subject is discussed more fully in Section 14 of this report.

The surveying and mapping industry has moved into the space age at a breathtaking pace. The industry has generally adapted quickly to the new technologies. The impact of the technology on the industry has been positive. It has opened up new horizons and made possible the capturing of infinitely more information in a much quicker and more efficient way. It has changed the industry from a labour-intensive to a capital-intensive, highly sophisticated technology for determining the geometry of the Earth. Comparable technological changes for mapping thematic information will proceed at a less rapid rate however, and it will continue to require a strong input of human judgement. The adoption of these new technologies by the industry has resulted in dramatic changes in the educational requirements of surveyors and mappers over the past three decades, and it will require even more far-reaching changes in the future.

10.5 Role of Industry in Research and Development

The surveying and mapping industry has played an important role in research and development. The competitive nature of the industry ensures that with some funding assistance, innovative technologies will continue to be developed by the industry.

The brief from the NRC head of Photogrammetric Research emphasizes the government programs that are available to provide industry with assistance in research and development. The survey companies could avail themselves more of "the government sponsored research assistance programs, such as the Industrial Research Assistance Program (IRAP) and Program for Industry Laboratory Projects (PILP) administered by the Industry Development Office of the NRC". The Task Force believes that the surveying and mapping industry could benefit from participation in these programs.

Recommendation 12:

> That the surveying and mapping industry avail itself of government sponsored research assistance programs such as the Industrial Research Assistance Program (IRAP) and the Program for Industry Laboratory Projects (PILP) administered by the Industry Development Office of the National Research Council.

10.6 Development of Management Skills For the High Tech Environment

Traditionally, surveying and mapping has been a technically-oriented profession. The primary need was for accurate measurement and the effective display of the resulting maps and charts. However, with the introduction of new technologies which facilitate very accurate measurements, and the introduction of digital technology for the storage and display of information, the skills required by surveyors and mappers are changing. Because measurements can be made very easily, quickly and accurately, there is now much less emphasis on the need for special measurement skills. There is nevertheless an increasing need for the development of management techniques and abilities for the high tech environment.

Spatial information systems are not an exclusive field of endeavour; they require a team approach and the skills of many specialists such as computer scientists, cartographers, surveyors, mappers, hydrographers and resource engineers. In order to be effective, the team needs a co-ordinator or manager who not only has a broad technical knowledge, but who also has training in the management of spatial information systems.

Recommendation 13:

> That curricula in university surveying and mapping programs reflect the need for the development of management skills for the high-tech environment.

11 GOVERNMENT POLICY AND PROGRAMS

11.1 Domestic

The surveying and mapping firms that responded to Questionnaire No. 1 reported that approximately 6 per cent of their gross domestic sales were attributed to the federal government, 16 per cent to provincial governments and 12 per cent to municipal governments, with the remaining 66 per cent coming from private sector clients. Applying these percentages to the estimated gross sales of $340 000 000 the federal government would account for $20 000 000, the provincial governments $55 000 000, and municipal governments $41 000 000.

The responses to Questionnaire No. 2 report that the amount of work contracted out to the private sector in 1983 by the federal government is $18 000 000, by provincial governments $14 000 000 and by municipal governments $1 000 000. The figures for the federal government from Questionnaires No. 1 and No. 2 compare favourably - $20 000 000 estimated from industry reports vs $18 000 000 reported by federal government agencies. However, there is not such close agreement with the amounts reported for provincial and municipal governments. This may be attributable to two factors. The Task Force did not compile an exhaustive mailing list for provincial and municipal government agencies, and the rate of response was better from the federal government surveying and mapping agencies. For these reasons the Task Force believes that the results indicated by Questionnaire No. 1 are probably more realistic, and that the estimate of $116 000 000 gross revenues in 1983 from all governments is realistic.

The findings of these two questionnaires clearly indicate that the three levels of government in Canada are major clients for the surveying and mapping industry, and that any government policies and programs respecting surveying and mapping have a substantial impact on the industry.

11.1.1 Contracting Out Policies

The Task Force analysis of the response to Questionnaire No. 2 (government agencies) indicates that for the period 1979 to 1983 governments on the average increased the percentage of total budget being contracted out to the private sector from 13 per cent in 1979 to 17 per cent in 1983. However, these figures are distorted by the fact that over the same period the Canadian Hydrographic Service increased its contracting out very substantially from 5 per cent to 15 per cent. Without the Hydrographic Service all other government agencies only increased their contracting out from 15 per cent to 17 per cent of total budget for the period 1979 to 1983. The amounts contracted out by individual agencies range from zero to 85 per

cent or 90 per cent of total budget, and some agencies are increasing while others are reducing the percentage being contracted out.

Government agencies interviewed were not all of the same opinion, but there was strong support for the following:

- Cost of services provided by industry was cheaper than the same service done in-house provided that all costs were considered.

- The quality of product provided by industry was equal to the quality of in-house production.

- A policy of contracting out afforded more flexibility in the implementation of government programs.

The briefs from, and interviews with, surveying and mapping firms indicated that the industry almost unanimously supports the following:

- Governments should retain a small core of technical expertise in-house but in general should contract out a greater proportion of their total surveying and mapping production to the private sector.

- Such a policy would tend to decrease the total cost of surveying and mapping programs to the taxpayers, and at the same time would afford the industry an opportunity to build a stronger financial base and technical capability and thereby a more competitive position in foreign markets.

- Government contracting out procedures are generally unsatisfactory because too much emphasis is placed on the lowest price and not enough consideration is given to other factors such as technical capability, past performance, capacity to produce the product within the terms of the contract, proximity to site of project, etc.

- Government contracting out policies should recognize the professional aspects of surveying and mapping and encourage innovative proposals.

- Governments should establish and announce longer term commitments to surveying and mapping programs - this would provide some stability because it would enable industry to make the necessary commitments with respect to qualified personnel and the substantial financial requirements of rapidly changing technologies.

- Governments should contract out more of their research and development requirements to the private sector and to universities.

Recommendation 14:

That government agencies substantially increase the level of contracting out of surveying and mapping projects to the private sector.

Recommendation 15:

That governments and industry work together to develop revised contracting out procedures that are satisfactory to both parties and that will be beneficial in the longer term to both government and industry.

Recommendation 16:

That governments clearly enunciate contracting out policies, and establish longer term (five years or more) surveying and mapping programs to enable industry to make the necessary commitments with respect to personnel and technical equipment.

Recommendation 17:

That governments contract out substantially more of their research and development requirements to the private sector and to universities.

Recommendation 18:

That the surveying and mapping industry develop performance standards which members would be expected to conform to, and that a mechanism be established to ensure that these standards are enforced.

The federal government has previously acknowledged the need for a contracting out policy. Treasury Board Canada in December 1978 issued an Administrative Policy Manual - Chapter S314 entitled "Science and Technology - Contracting out". The executive summary of this manual summarizes the contracting out policy in part as follows:

> "The government's policy of contracting out its science and technology requirements reflects its belief that it is in the national interest to encourage the fullest possible participation of Canadian industry in meeting these needs, to stimulate industrial innovation and thus provide additional benefits to the economy.

> "Subject to overall financial constraints, the government's mission oriented science and technology requirements in the natural sciences, and in the human science fields of urban, regional and transportation studies, will be contracted out to the private sector, and especially to Canadian industry, except in specific limited circumstances as prescribed."

The Task Force fully supports the above policy as stated by the Treasury Board. The Task Force perceives a need for an evaluation of the policy and a report to Treasury Board on its implementation.

Recommendation 19:

> That the Ministry of State for Science and Technology conduct an evaluation of the science and technology contracting out policy which was enunciated in 1978, and that the policy be reaffirmed and fully implemented.

11.2 Foreign

An analysis of the responses to Questionnaire No. 1 reveals that contracts in foreign countries account for about 5 per cent of total gross revenues and amounted to about $3 000 000 in 1983. However, this total is for 162 out of 1139 firms and therefore does not fully reflect the size or scope of the export market. It is estimated that Canadian surveying and mapping firms had foreign contracts totalling $40 000 000 in 1984 but that annual export sales on the average total $60 000 000 per year, or 18 per cent of the gross annual sales of the surveying and mapping industry. The further development of the export of surveying and mapping services was addressed by a number of the respondents to the Task Force. Some of the suggestions were addressed to the industry, but a large number dealt with government policies and programs which could be of assistance.

Recommendation 20:

> That the federal and provincial governments provide increased support to the industry in the development of the export market for surveying and mapping services.

The government support to the surveying and mapping industry in the development of export markets could include but not be limited to the following:

- Keep trade commissioners and other government representatives fully informed of the extent of Canadian expertise in the surveying and mapping field.

- Provide active marketing assistance to industry and actively assist industry in co-ordinating their efforts in the procurement of foreign contracts.

- Provide increased financial aid for feasibility and marketing studies.

- Tax incentives could be provided to assist industry to finance the substantial requirements for state of the art technical equipment.

- Adopt a policy of contracting out more work in Canada - work done in Canada for Canadian governments is a common measure used by foreign clients to assess the capability of Canadian firms, and is considered by them to be a good recommendation. Such a policy would assist Canadian firms to establish a sound base from which they could export.

- Provide more direct assistance for Canadian displays of new technology at international trade shows.

- Increase support of trade missions and marketing in countries that have major requirements for surveying and mapping.

- Spatial information systems are an increasingly viable export commodity - there is a need to build models in Canada that can be used for demonstration purposes.

- Industry requires one strong federal government agency with which to interact. The separation of the Trade Commissioner Service, the PEMD office, and other support services from the old Department of Industry, Trade and Commerce has caused problems and delays.

- The processing of applications under the Program for Export Market Development needs to be fast tracked. The window for export opportunities is often of no more than one or two weeks duration, and the present application processing time of six to eight weeks is unsatisfactory.

- Government should provide more and easier financing assistance for bid and performance bonds, as well as insurance and overall financial arrangements for overseas projects.

- Government and industry should take an aggressive approach to all international lending agencies to keep them informed of Canada's expertise in surveying and mapping and to ensure that Canadian industry receives its fair share of surveying and mapping contracts.

There is a growing realization that a more aggressive sales campaign by both government and industry will be needed if Canada is to compete successfully in the foreign market. The Program for Export Market Development (PEMD) in the Department of External Affairs provides up to 50 per cent of the costs incurred in the penetration of new markets. This program is used by a number of larger firms in the development of export markets. However, the Task Force has concluded that a successful export development policy will need to be a co-operative one, and that better dollar value would be achieved through a team approach rather than by individual firms. The Task Force believes that consideration should be given to the associations such as CAAS and CAHOSI to take advantage of PEMD funding and send their association executives to international symposia and on market identification trips.

Recommendation 21:

> That the surveying and mapping industry avail itself more of the funding available through the Program for Export Market Development (PEMD) to send executives as industry representatives to international trade symposia and on market identification trips.

The co-operative aspect of the development of foreign markets cannot be stressed too much, and while there is undoubtedly a need for more government assistance there is also a need for industry to communicate on a regular basis with the appropriate government departments and to work together co-operatively.

Recommendation 22:

> That the member firms of the surveying and mapping industry communicate on a regular basis with sector specialists at the Department of Regional Industrial Expansion and with the geographical desk officers at the Department of External Affairs to keep them informed of their capacities and capabilities and their participation in projects both in Canada and abroad.

Recommendation 23:

> That the Canadian Institute of Surveying invite representatives from industry, government and universities to participate in a seminar on the development of a national policy and a unified strategy for the export of surveying and mapping services.

Recommendation 24:

> That the surveying and mapping industry co-operatively prepare a comprehensive directory of Canadian surveying and mapping companies which have the interest and capacity and capability to

participate in foreign markets. The directory should give a detailed description of each firm and should be distributed widely to trade commissioners, embassies, consulates and any other Canadian federal or provincial offices overseas.

12. ISSUES FACING THE INDUSTRY

The 45 briefs received by the Task Force and the 87 interviews with a broad cross-section of the members of the surveying and mapping industry and with educational institutions and a number of government agencies revealed a wide spectrum of issues which are of concern to the industry. Some of these issues are dealt with in other sections of this report, but the following are the concerns most frequently expressed in the briefs and by those who were interviewed.

12.1 Organization of the Industry

Perhaps the most urgent and pressing issue facing the whole surveying and mapping industry is the question of organization. The total industry, including all the various sectors, embraces about nine thousand persons in the private sector, which in total represents a relatively small occupational group within society. In spite of this lack of size, the persons engaged in the broad fields of surveying and mapping support 24 separate organizations, which are described in Section 3 of this report. Most of these organizations are primarily concerned with the technical and professional aspects of surveying and mapping. Their membership is open to all persons with some form of technical or professional training or education, and includes those who are employed in the public sector as well as those in private practice or employed by large companies. These organizations disseminate information on the availability and utilization of new technology, provide continuing education opportunities for members, publish newsletters, and concern themselves with professional matters; they generally do not, however, concern themselves with public relations, marketing or promotion of the industry.

The two exceptions are the Canadian Association of Aerial Surveyors and the Canadian Association of Hydrographic and Ocean Surveying Industries which are both established as trade organizations with the objective of promoting aerial and hydrographic surveying in the private sector.

One result of supporting this multitude of organizations within surveying and mapping in both the public and private sectors is that there is a singular lack of purpose, and a great deal of duplication of effort resulting in unnecessarily high administrative costs. The industry is fractured and each sector is jealously guarding its own interests. There is very little communication between the different sectors, and there is a general lack of recognition of the reality that, in fact, they are all participating in the same basic occupation - the process of gathering, storing and disseminating spatial information.

Because the individuals involved in surveying and mapping are often involved in several different sectors of the industry, or qualified in more than one discipline, they find it necessary to hold multiple memberships and support several different organizations.

This general lack of cohesiveness in the industry has been recognized by many, but a workable solution is not readily discernible. Ideally, the industry should come together in an umbrella organization as was proposed at the Third Colloquium on Survey Education in 1977. The proposal was to establish a Canadian Survey Federation which "could set and monitor the total Canadian survey education scene, from the survey technician to the survey professional; it would cross discipline lines as well. Through this federation, surveying could lobby federal and provincial government departments and agencies, pointing out needed changes in legislation and providing input into proposed bills of interest to the survey profession". This proposed federation would not be a separate organization as such, but would be an umbrella of some sort under which these 24 organizations could act in unison.

12.1.1 National Administrative Centre for Surveying and Mapping

The Task Force favours the establishment of an umbrella organization as an ultimate goal, but there are too many differences and too many obstacles to overcome without a great deal of discussion and understanding amongst the participating groups. However, as a first step toward the establishment of an umbrella organization the Task Force supports and endorses a current proposal which envisions the establishment of a National Administrative Centre for Surveying and Mapping. It is proposed that the administrative centre would be supported by the CIS, CCLS, CAAS, CAHOSI, CHA, CCA, CACSTTO and any other surveying and mapping organizations which might qualify for participation. The initial assumption is that the only item to be considered is centralized administration, with each organization remaining completely autonomous.

There would be some financial benefit to be realized by the establishment of the National Administrative Centre for Surveying and Mapping through more effective utilization of office space, office equipment and administrative personnel. However, the Task Force sees the much improved lines of communication amongst the participating organizations as the greatest benefit.

Recommendation 25:

That a National Administrative Centre for Surveying and Mapping be organized by the Canadian Institute of Surveying with membership consisting of the CIS, CCLS, CAAS, CAHOSI, CHA, CCA, CACSTTO and any other surveying and mapping organizations which might qualify for participation.

The terms of reference of the proposed national administrative centre would be as follows:

1. To establish a central office which would provide administrative and office support as required to member organizations;

2. To publish a jointly sponsored newsletter for distribution to the members of all participating organizations;

3. To organize the co-sponsoring of educational seminars and technical programs for members of the participating groups;

4. To develop and implement a public relations program for surveying and mapping;

5. To foster and encourage good relations, communication and co-operation amongst the member organizations.

12.1.2 Surveying and Mapping Consulting Association of Canada

The Task Force has identified many areas of concern within the surveying and mapping industry that could be more effectively addressed by a national association of surveying and mapping consulting firms. Such an association could be modelled after the Association of Consulting Engineers of Canada, and a suitable name could be selected by the participating firms. The principal concerns which might be considered by such an organization could include the following:

1. The public is not adequately informed as to the role of the surveying and mapping industry within society.

2. There is a need for the industry to be more aggressive in the marketing of surveying and mapping services both in Canada and abroad.

3. The lines of communication between governments and the surveying and mapping industry need to be improved.

4. The contracting out policies of some governments are currently most unsatisfactory from the point of view of industry, and there is a need for a strong representative group to negotiate on behalf of industry in this respect.

Recommendation 26:

That those private sector firms that offer surveying and mapping services to the public form the Surveying and Mapping Consulting Association of Canada.

The proposed association would have the following purposes and objects:

1. To assist in promoting satisfactory business relations between the members of the association and their clients;

2. To promote cordial relations among the various consulting surveying and mapping firms in Canada;

3. To foster the interchange of professional, management and business experience and information amongst the member firms;

4. To act when necessary to safeguard the interests of the consulting surveying and mapping firms;

5. To further the maintenance of high professional standards in the surveying and mapping consulting profession.

The objects as stated above would be achieved through the implementation of programs such as:

1. Providing standardized contract agreement documents to member firms and clients;

2. Maintaining an up-to-date directory of member firms describing the fields of specialization and the capacities and capabilities of each firm;

3. Publishing a newsletter to keep members informed of government programs and policies affecting the surveying and mapping industry.

4. Developing and enforcing a professional code of ethics for surveying and mapping consulting practice;

5. Organizing educational courses and seminars for the benefit of member firms;

6. Developing and implementing a public relations program designed to inform the public about the role of the surveying and mapping industry in Canada.

7. Developing new markets for surveying and mapping both in Canada and abroad.

The Task Force appreciates that the success of the proposed Surveying and Mapping Consulting Association would depend to a large extent on full participation by the firms which now support the Canadian Association of Aerial Surveyors and the Canadian Association of Hydrographic and Ocean Surveying Industries. Perhaps the proposed Surveying and Mapping Consulting Association could be established initially by the merging of these two existing associations, and then broadened to include other firms engaged in providing services in all the other surveying and mapping disciplines. The ultimate objective should be to have one Surveying and Mapping Consulting Association that embraces all firms offering surveying and mapping services to the public. Such an association would be able to represent the whole surveying and mapping industry much more effectively.

The Task Force suggests that the proposed Surveying and Mapping Consulting Association be a participant in the National Administrative Centre for Surveying and Mapping as proposed in the previous section of this report.

12.2 Official Recognition of the Technician/Technologist

Many respondents in both the briefs and the interviews expressed concern that official recognition of the technician/technologist has yet to be realized, despite the fact that certification procedures have been in effect in some provinces for 10 years or more. Section 3.9 of this report lists the associations of survey technicians and technologists in Canada. Although these associations have been striving to achieve some form of official recognition, little can be achieved without the full support of the land surveyors associations and corporations.

Recommendation 27:

That the Canadian Institute of Surveying, the Canadian Council of Land Surveyors and the Canadian Association of Certified Survey Technicians and Technologists jointly explore mutually acceptable ways of making provisions for the official recognition of technicians and technologists.

12.3 The Economy

The weakness of the economy has had a severe impact on most surveying and mapping firms, especially those which are heavily dependent on the land development, construction and resource development industries. Some firms have had to reduce their staff drastically - others have become involved in other endeavours which have enabled them to cope with the problem. Surveying and mapping generally are heavily dependent on economic expansion and development, and the Task Force recognizes that traditional surveying and mapping services will not be as much in demand until such time as general economic conditions improve.

The recent reduction in demand for surveying and mapping has been attributed primarily to the weak economy. However, the Task Force points out that there may be other factors such as changing societal values and long-term structural change in the economy which need to be recognized.

12.4 Space Age Technology

Some of the members of the industry are concerned that the introduction and utilization of some space age technologies such as satellite positioning systems will substantially reduce the employment opportunities for persons in the surveying and mapping industry. However, most of the members interviewed were of the opposite opinion and felt that the new technology would tend to increase the capabilities of the industry and at the same time increase opportunities for employment, although the type of employment would probably change and some additional education and retraining would be required. The Task Force supports this latter view.

12.5 Export

Firms involved in the export of surveying and mapping services are concerned about the competitive position of Canada in foreign markets; they have made a number of suggestions with respect to policies and programs that would assist them in this area. The subject is discussed more fully in Sections 8.2 and 11.2.

12.6 Spatial Information Management

The question of industry involvement in the development, management and utilization of spatial information systems is by far the most pressing issue facing the industry. The need for the whole surveying and mapping industry to become more knowledgeable about and involved in spatial information management was stressed on numerous occasions during the course of the study. The subject is discussed in detail in Section 14.

12.7 Public Relations

Many members of the surveying and mapping industry are concerned that the public is not adequately informed about the role of surveying and mapping in Canada. A brief description of that role is provided in Section 4.3 of this report, and Sections 12.1.1 and 12.1.2 identify two new organizations - The National Administrative Centre for Surveying and Mapping and the Surveying and Mapping Consulting Association of Canada - both of which would assume the responsibility for an aggressive public relations program on behalf of the whole industry. Most of the present 24 surveying and mapping organizations engage in some form of public relations, but it is felt that one or two larger groups speaking on behalf of the whole industry could be more effective.

12.8 Education

The surveying and mapping curricula at universities and technical institutions are of major concern to the surveying and mapping industry because it is essential that the industry have people with the best in technical and professional education if they are to be competitive in both domestic and foreign markets. The rapidly changing technologies, the developing spatial information systems, the need for communication and managerial skills, and the recognition of the applied geography dimension are some of the factors which need to be addressed by the educational institutions. The Task Force has made some recommendations with respect to education in Section 7.

13. PROSPECTS

The prospects for the future of the surveying and mapping industry vary widely from one sector to another, and since there appear also to be differences between the foreign and domestic markets they will be discussed separately.

13.1 Domestic

The surveying and mapping industry is generally heavily dependent on various forms of exploration and development, and therefore the market prospects for surveying and mapping will depend on the amount of activity in these areas.

Chart 14 illustrates the rates of change in construction investment in constant dollars as reported by the Economic Council of Canada, and the rates of change in gross surveying and mapping revenues in constant dollars as reported by the respondents to Questionnaire No. 1. The statistics provided by Questionnaire No. 1 may not be conclusive, but they do illustrate that when construction investment is declining there is a more or less parallel decline in the volume of surveying and mapping. The forecasts of the Economic Council of Canada show steadily increasing construction investment for the years 1985, 1986 and 1987, which is a good indication that there will be a similar improvement in the domestic market for surveying and mapping services.

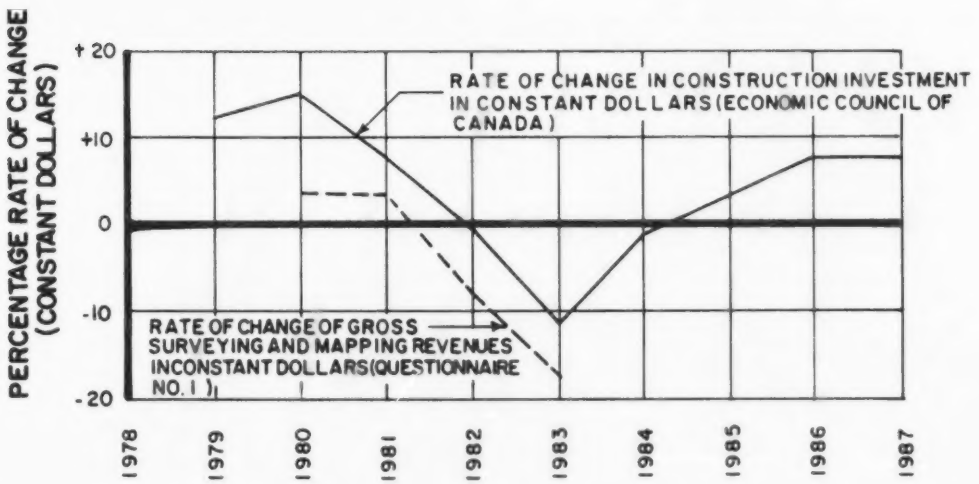

Chart 14.

Comparison of Rates of Change in Construction Investment and in Gross Surveying and Mapping Revenues.

Land surveying is very much dependent on land and resource development. Consequently, the current weak economy and the general lack of development has created a severely depressed market for firms primarily involved in land surveys, and the volume of work probably will not increase significantly until economic conditions improve. As an example, the Canada Mortgage and Housing Corporation reports total housing starts in Canada as follows:

1979	197 049
1980	158 973
1981	177 973
1982	125 860
1983	162 645
1984	134 900

This indicates a substantial reduction in housing construction in 1984 and therefore a similar reduction in the associated surveying and mapping requirements. However, the Economic Council of Canada predicts housing starts of 143 200 in 1985, 141 000 in 1986, and 161 500 in 1987 which indicates that there should be a generally increasing land surveying activity over the next two or three years.

Photogrammetric Mapping: The major clients in the domestic market for photogrammetric mapping are the federal and provincial governments. The role of the Surveys and Mapping Branch of Energy, Mines and Resources will change from data gathering to data management. Consequently they will not be involved as much as previously in map production - either in-house or by contract to the private sector. One of the options being examined is to have the mapping done by the provinces under a cost sharing arrangement for data gathering with the Surveys and Mapping Branch. The amount of work generated for the private mapping industry would then depend to a large extent on the various provincial policies with respect to contracting out. The Task Force has identified a wide range of practices - some provinces contract out 80 per cent to 90 per cent of their mapping requirements while others do all their mapping in house.

Hydrographic Surveys: The 1983 CAHOSI report paints a very optimistic picture of the opportunities for hydrographic surveys by the private sector. These opportunities in the domestic market will arise from two sources:

- Canadian offshore oil and gas and mineral exploration and development work, including the Atlantic, the Arctic and the Pacific continental shelf. This opportunity will depend on the level of exploration and development activity in these areas. The report identifies a current market of $50 million from the private sector (mostly offshore oil and gas companies) with a potential for $150 million.

- The continuation and expansion of federal government policies and programs in contracting out hydrographic surveys to the private sector. The report sees a current market of $5 million with a potential of $30 million from government sources.

Spatial Information Management: This is a rapidly expanding field which is probably the most challenging and exciting of all opportunities available to the surveying and mapping industry. Current work in this field is being done mostly by governments and utility and resource development companies in the design and development of spatial information systems for their own use. The surveying and mapping industry will be involved in systems design, data acquisition, software development, and building and marketing spatial information management technology.

13.2 Foreign

The prospects for work in foreign markets are excellent in most sectors of surveying and mapping, but international competition is strong and a positive and co-ordinated marketing strategy will be required if the Canadian surveying and mapping industry is to maintain or increase its share of that market. Foreign market opportunities are developed mainly from individual company initiatives, trade mission intelligence, international development bank notices and Canadian aid projects for developing countries.

Canada now enjoys a major participation in the available international market for surveying and mapping, but to maintain or improve this position Canada will need to develop a national policy and a unified strategy for the export of surveying and mapping services. The Task Force has made some recommendations in this respect in Section 11.2 of this report.

Land Surveying: Before 1975, the World Bank concentrated on agricultural development projects such as irrigation schemes, commodity development, tree crop plantations, agribusinesses, etc., and did not become very much involved in land reform. This policy has changed, however, and the bank will now help member governments with the specifications and design of land reform programs. This will include financial and technical aid with land surveys, registration of land titles and similar services.

The bank recently approved a few of these projects with emphasis on land titling and the establishment of a reliable cadastre which can be used for land acquisition and redistribution, land consolidation and land taxation.

The Canadian surveying and mapping industry is well qualified to undertake these projects because of its mapping expertise, its knowledge of and experience with a variety of land titles and land registry systems, and its experience and expertise in spatial information management. There is a very substantial foreign market for this type of expertise and some excellent opportunities for the surveying and mapping industry.

Photogrammetric Mapping: The prospects are good for a continuing demand in the foreign market for photogrammetric mapping. The development of spatial information systems will create a greater need for the transition to digital mapping.

Hydrographic Surveys: The 1983 CAHOSI report indicates present international markets of $60 million and potential markets of $220 million for hydrographic surveys and ocean related industries. The opportunities for hydrographic surveying in the foreign market are primarily in two areas:

- offshore exploration and development of natural resources, especially oil and gas;

- the delimitation and survey of the exclusive economic zones of developing coastal states.

Spatial Information Management: There is increasing development of spatial information systems in developing countries and consequently an increasing opportunity in providing consulting expertise in systems design and management, and in software development. There is a need for an aggressive marketing strategy in the field of spatial information management.

Remote Sensing: There is an increasing need and a good opportunity for the surveying and mapping industry in developing countries for expertise in the utilization of remote sensing techniques for agricultural monitoring programs, geological exploration and development of resource inventories. This is another field which should be discussed at the proposed seminar on the development of a national policy on the export of surveying and mapping services (Section 11.2).

14. NEW HORIZONS

Futurists like Toffler and Naisbitt have identified a major shift taking place in our society. They argue that we are moving rapidly from being an industrial society to a society based on the creation and distribution of information. The impact will not be as noticeable in some sectors of society as in others, but nowhere will the change be more dramatic than in the field of surveying and mapping.

The basic traditional role of the whole surveying and mapping industry has been one of collecting information about our physical environment and storing and displaying that information in the form of maps and charts. Because of their nature, maps and charts display information in a static form - they do not change until revisions are undertaken and revised editions are produced. However, the whole process is undergoing a massive change. Information is being collected and stored in digital form from aerial surveys, remote sensing, hydrographic surveys and ground surveys. It is now much easier to combine sets of data from many different sources and, because of the flexible nature of the storage medium, revisions to the data can be done on a continuing basis.

The storage of data in digital form presents unlimited flexibility in the presentation of information. Different scales can be produced at will, multiple data sets can be combined and tailored to meet the user's requirements, and virtually unlimited flexibility in the presentation of information can be achieved. Dynamic systems such as the "electronic chart" for navigation purposes, and the "electronic map" for automobiles are now a reality. Thematic maps which were not previously feasible are now being produced by remote sensing techniques. The monitoring of environmental change has become feasible on an ongoing and continuous basis.

Coupled with revolutionary changes in the methods of gathering, storing and presenting information on the physical environment is the realization that the "information float" has been collapsed. The lapse of time between the gathering of information and the presentation of that information has been reduced from a period of a year or two in the case of topographic maps, to a matter of a few hours in the presentation of remote sensing data.

There are other changes. The societal value system is placing more emphasis on the quality of life rather than on material things. For instance, there is an increasing awareness and appreciation of the fragility and value of our physical environment. This results in a massive need for increasingly up-to-date information on environmental impacts before any development is undertaken. Society has also become aware of the shrinking supply of the earth's natural resources, and of the need to use them and develop them in the most effective way possible. This will create an increasing demand for more information.

The foreign market is now presenting opportunities for firms which have expertise in information management. It has been said that some third world countries are moving directly from the agricultural era into the information era and that they are bypassing the industrial era. In any event, third world countries have a need for spatial information systems for developing resource inventories and resource management programs, land reform programs, agriculture and forestry evaluation and planning, effective utilization of water resources, and many other purposes. The development of information systems could become a substantial export commodity for Canadian surveying and mapping firms.

The Challenge:

The demand for more and more information about our physical environment presents an unprecedented challenge to the surveying and mapping industry. Our role, our tasks and our objectives will need to be re-assessed and reoriented to the combined realities of new technologies and new demands for information. We will have to rethink our role to decide whether we should cling to the traditional role of collecting and storing information, or whether we should also become involved in the management and utilization of information.

The industry has traditionally believed that it is the best qualified sector in society to carry out the surveying and mapping function. This belief is generally well founded - Canadians have been world leaders in the development of innovative mapping programs, new positioning systems, automated mapping and charting. However, this leadership position is being challenged and the industry will need to develop new skills and new technologies.

In fact, the Task Force believes in fact that under the circumstances there is no choice, because if we are to survive as a viable industry we must move forward to meet the challenge and grasp the opportunities being presented.

The transition of the surveying and mapping industry to the new reality of information systems is already happening. A few firms are involved in digital mapping; remote sensing is finding more and more applications; governments and industry are developing spatial information systems and involving the private sector to a limited extent. In the opinion of the Task Force, however, the transition is much too slow, and we must take determined, positive action immediately and encourage the whole surveying and mapping industry to become involved in spatial information management.

Leadership:

The Task Force perceives that there is a lack of leadership in developing strategies for co-ordinating the development of spatial information systems, standards and procedures for exchanging information, and tools and procedures for effectively utilizing the information. Because this is a national concern it is logical that this role should be undertaken by a national group such as the Canadian Council on Surveying and Mapping, which consists of all the principal surveying and mapping officers of the federal and provincial governments.

Recommendation 28:

> That the Canadian Council on Surveying and Mapping should take a lead role in co-ordinating the development of spatial information systems and distributed information networks, and that they should give special attention to the need to develop standards for the exchange and effective utilization of spatial information.

Industry Participation:

The Task Force believes that the whole surveying and mapping industry will have to make the transition from its traditional role to one of more involvement in spatial information systems. This will apply to virtually all sectors of the industry. For instance, while land surveyors are making some initial changes, the Task Force believes that their data collection, data storage and data presentation should increasingly be in digital form. They could readily be involved in the development and management of information systems for smaller municipalities and for large industrial developments.

The photogrammetric mapping industry is moving rapidly into digital mapping, but there is a need to go one step further and become more involved in the utilization and management of the final product. The same applies to the other sectors - geodesy, remote sensing, and hydrographic, engineering and mining surveying; a focus on spatial information management is required.

Recommendation 29:

> That the private sector surveying and mapping firms focus their resources on the transition from their traditional role to one of more involvement in spatial information management.

Recommendation 30:

That the Canadian Institute of Surveying take an active role in encouraging and assisting the surveying and mapping industry to become more involved in spatial information systems by publishing relevant papers, sponsoring seminars, organizing educational courses, and generally creating an awareness of the need to become involved.

Education:

The surveying and mapping community, including both the public and private sectors, will need to undertake a massive educational program in spatial information studies at both the professional and technical levels. This will apply across the whole broad spectrum of surveying and mapping, and would therefore best be co-ordinated by the Canadian Institute of Surveying. The assistance and co-operation of all educational institutions will be required. Some movement in the right direction is already being made by the University of New Brunswick and University of Calgary and possibly by others. However, the Task Force believes that a much more positive and active position on spatial information systems needs to be taken by all educational institutions offering surveying and mapping programs.

There is perhaps an even more pressing need to develop courses for practitioners who would like to become involved, but lack the necessary knowledge and expertise.

Recommendation 31:

That universities and technical institutes review and revise their undergraduate and graduate programs to emphasize and focus on the objective of shifting the role of the surveying and mapping community to one consisting of the development, maintenance and management of spatial information systems.

Recommendation 32:

That universities and technical institutes develop courses on the development, maintenance and management of spatial information systems for practising surveyors and mappers in both the public and private sectors.

Recommendation 33:

That the Canadian Institute of Surveying assume responsibility for the development and co-ordination of continuing education programs in the science of spatial information management.

15. CONCLUSION

The Task Force strongly believes that the issues and trends identified in this study are matters of immediate concern, and that they should be addressed at the earliest possible moment. The Canadian Institute of Surveying should assume a leadership role in ensuring that the recommendations in this report are acted upon, and that the surveying and mapping industry be kept informed of progress.

The Task Force study has highlighted the fact that the surveying and mapping industry is relatively small and fragmented, and that there is a need for industry partners to work together as a unified group to meet the challenges of the information age.

Recommendation 34:

> That the Canadian Institute of Surveying assume a leadership role in ensuring that the recommendations in this report are acted upon.

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APPENDIX 1

Questionnaires and Request for Briefs

QUESTIONNAIRE - 1

This questionnaire is to be completed by those firms engaged in surveying, mapping and related activities. (e.g. geographic information, remote sensing, etc.)

Only one questionnaire is to be completed for each firm.

1. What region is your head office located in?

_____ Atlantic
_____ Quebec
_____ Ontario
_____ Prairie Provinces
_____ British Columbia
_____ Yukon & Northwest Territories

2. (a) What is the corporate structure of your firm?

_____ Corporation _____ Number of shareholders
_____ Partnership _____ Number of partners
_____ Sole Proprietorship

(b) Number of years firm has been in existence? _____

(c) Is your firm engaged in activities other than surveying and mapping (engineering, planning, land development, other)?

____ YES
____ NO

If yes, please indicate activities: _____
_____
_____
_____

3. On the basis of gross billing what was the approximate percentage breakdown of your firm's surveying and mapping activities in each of the following regions in your last fiscal year?

_____ Atlantic Provinces
_____ Quebec
_____ Ontario
_____ Prairie Provinces
_____ British Columbia
_____ Yukon & Northwest Territories
_____ Foreign
100%

4. Please report total gross billings (domestic and foreign) for your firm in each division of surveying and mapping for your five fiscal years ended during the listed calendar years (estimated gross billings would be satisfactory):

	1979 $(000's)	1980 $(000's)	1981 $(000's)	1982 $(000's)	1983 $(000's)
Cadastral Surveys					
Geodesy & Control Surveys					
Photogrammetric Mapping					
Hydrography					
Cartography					
Geographic Information Services					
Engineering Surveys					
Mining Surveys					
Remote Sensing (including aerial photography)					
Geophysical Surveys					
Other (please specify)					
Total					

5. Please report gross billings for all foreign work done by your firm in each division of surveying and mapping for your five fiscal years ended during the listed calendar years (estimated gross billings would be satisfactory):

	1979 $(000's)	1980 $(000's)	1981 $(000's)	1982 $(000's)	1983 $(000's)
Cadastral Surveys					
Geodesy & Control Surveys					
Photogrammetric Mapping					
Hydrography					
Cartography					
Geographic Information Services					
Engineering Surveys					
Mining Surveys					
Remote Sensing (including aerial photography)					
Geophysical Surveys					
Other (please specify)					
Total					

6. How do you assess your firms profitability for each of your five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
___ better than adequate	___ better than adequate	___ better than adequate	___ better than adequate	___ better than adequate
___ adequate	___ adequate	___ adequate	___ adequate	___ adequate
___ less than adequate	___ less than adequate	___ less than adequate	___ less than adequate	___ less than adequate

7. What were your firms reported shareholders equity or proprietors/ partners capital for each of your five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
_____	_____	_____	_____	_____

8. What was the book value in dollars of your firms surveying and mapping equipment for each of your five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
_____	_____	_____	_____	_____

9. What is the current replacement value in dollars of your firms surveying and mapping equipment?

_____

10. On the average, how many people engaged in surveying and mapping were employed by your firm (including partners, shareholders and sole proprietors) in the following years?

1979	1980	1981	1982	1983

11. How many personnel do you currently have on staff in each of the listed categories? Where personnel are engaged in more than one category, indicate only primary activity.

	PROFESSIONAL	TECHNICAL
Cadastral Surveys		
Geodesy & Control Surveys		
Photogrammetry		
Hydrography		
Cartography		
Geographic Information Services		
Engineering Surveys		
Mining Surveys		
Remote Sensing		
Geophysical Surveys		
Other (please specify)		
Total	+	=

In addition, how many administrative staff in support of the above are currently employed by your firm?

Total all staff.

12. How many personnel currently on your surveying and mapping staff have the following qualifications (personnel may be listed more than once):

_____ Professional Land Surveyor (e.g. BCLS, OLS, CLS, etc.)

_____ Professional Engineers

_____ Other professional qualifications

_____

_____ Certified Technicians and Technologists

13. How many personnel currently on your surveying and mapping staff have the following academic qualifications (list the highest qualification only):

_____ Post Graduate Degree or Diploma

_____ Bacnelor degree

_____ Technologist diploma

_____ Technician diploma

_____ High School

_____ Other

14. In your fiscal year 1983, what was the approximate percentage of your gross billings in each of the following categories?

Domestic	Foreign
_____ Federal Government	_____ Foreign Government
_____ Provincial Government	_____ Canadian Aid Agencies (CIDA etc.)
_____ Municipal & County Gov't.	_____ International Aid Organizations (World Bank, U.N., etc.)
_____ Private	_____ Private

15. This completes the questionnaire, but we would appreciate having your comments on some or all of the following:

(a) What new areas of expertise should surveying and mapping firms be expanding into?

(b) What changes in federal and/or provincial government policies would enable you to expand your business in both the domestic and foreign fields?

(c) What technological advances are having the most impact on your business and how do you see these developing?

(d) What areas of surveying and mapping should research and development priority be given to?

(e) What is the approximate dollar value of research and development carried out by your company?

(f) Do you make use of any government of Canada agencies in research and development or other programs?

(g) Does federal government financial, marketing support, etc. assist your company when in competition with other countries on foreign contracts?

(h) Does provincial government financial, marketing support, etc. assist your company when in competition with other countries on foreign contracts?

(i) Do you see a need for the Canadian Institute of Surveying to be more active in the promotion of the private surveying and mapping industry? If so, how could this best be accomplished?

QUESTIONNAIRE - 2

This questionnaire is to be completed by public sector surveying, mapping and related organizations.

Only one questionnaire is to be completed for each organization.

1. Name and address of the organization.

_____

_____

_____

_____ Telephone: _____

2. What is the structure of your organization?

_____ independent agency

_____ branch of a larger department

_____ unit of a larger branch

_____ other (please specify)

3. What level of government does your organization service?

_____ local

_____ regional

_____ provincial

_____ national

4. What has been your total capital and operating budget in dollars for your five fiscal years ended during the listed calendar years:

	1979	1980	1981	1982	1983
Capital	_____	_____	_____	_____	_____
Operating	_____	_____	_____	_____	_____

5(a) What percentage (approximate) of your capital budget has been allocated to each of the surveying and mapping sectors listed below for each of your five fiscal years ending during the listed calendar years?

	1979	1980	1981	1982	1983
Cadastral Surveys					
Geodesy & Control Surveys					
Photogrammetric Mapping					
Hydrography					
Cartography					
Geographic Information Services					
Engineering Surveys					
Mining Surveys					
Remote Sensing (including aerial photography)					
Geophysical Surveys					
Other (please specify)					
Totals					

5(b) What percentage (approximate) of your operating budget has been allocated to each of the surveying and mapping sectors listed below for each of your five fiscal years ending during the listed calendar years?

	1979	1980	1981	1982	1983
Cadastral Surveys					
Geodesy & Control Surveys					
Photogrammetric Mapping					
Hydrography					
Cartography					
Geographic Information Services					
Engineering Surveys					
Mining Surveys					
Remote Sensing (including aerial photography)					
Geophysical Surveys					
Other (please specify)					
Totals					

6. On the average, how many people engaged in surveying and mapping were employed by your organization in the following years?

1979	1980	1981	1982	1983

7. How many personnel do you currently have on staff in each of the listed categories? Where personnel are engaged in more than one category, indicate only primary activity.

	PROFESSIONAL	TECHNICAL
Cadastral Surveys		
Geodesy & Control Surveys		
Photogrammetry		
Hydrography		
Cartography		
Geographic Information Services		
Engineering Surveys		
Mining Surveys		
Remote Sensing		
Geophysical Surveys		
Other (please specify)		
Total	+	= _____

In addition to the above, how many administrative and support staff are currently employed by your organization? _____

Total all staff _____

8. How many personnel on your surveying and mapping staff have the following qualifications (personnel may be listed more than once):

_____ Professional Land Surveyor (eg BCLS, OLS, CLS, etc.)

_____ Professional Engineers

_____ Other professional qualifications

_____

_____ Certified Technicians and Technologists

_____ Other

9. How many personnel currently on your surveying and mapping staff have the following academic qualifications (list the highest qualification only):

_____ Postgraduate Degree or Diploma

_____ Bachelor degree

_____ Technologist diploma

_____ Technician diploma

_____ High school diploma

10. What was the book value, in dollars, of your organization's surveying and mapping technical equipment at the end of your five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
_____	_____	_____	_____	_____

11. What is the current replacement value, in dollars, of your organization's surveying and mapping equipment?

_____

12. What percentage (approximate) of your budget was allocated to contracting out services in each of your five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
_____	_____	_____	_____	_____

13. What factors in your opinion may have a major impact on the role and structure of your organization in the next 5 to 10 years?

14. What significant changes, if any, do you anticipate over the next 5 to 10 years with respect to:

(a) your relationships with other public agencies;

(b) your relationships with the private sector;

(c) your personnel requirements;

(d) your technology requirements;

(e) your technical equipment requirements;

(f) your contracting out policies.

15. What role, if any, can your agency play in formulating public policies dealing with surveying, mapping and related activities?

QUESTIONNAIRE - 3

This questionnaire is to be completed by public companies and crown corporations having capabilities and/or interests in surveying and mapping.

Only one questionnaire is to be completed for each organization.

1. Name and address of the organization.

_____

_____

_____

_____ Telephone: _____

2. What is the structure of your organization?

_____ independent agency

_____ branch of a larger department

_____ unit of a larger branch

_____ other (please specify)

3. In which of the following areas is your company most involved?

_____ Hydro/Power Corporations

_____ Petroleum related (oil, gas, pipeline)

_____ Geophysical

_____ Railway

_____ Forestry

_____ Mining

_____ Telecommunications

_____ Engineering

_____ Other (specify)

4. What percentage of your surveying and mapping activities were contracted out in the five fiscal years ending during the listed calendar years?

	1979	1980	1981	1982	1983
Domestic	_____	_____	_____	_____	_____
International	_____	_____	_____	_____	_____

5. What level of surveying and mapping services does your organization provide/require?

_____ regional

_____ provincial

_____ national

_____ international

6. What has been your total budget related to surveying and mapping activities for the five fiscal years ending during the listed calendar years?

	1979	1980	1981	1982	1983
Operating	_____	_____	_____	_____	_____
Capital	_____	_____	_____	_____	_____

7. What percentage of your surveying and mapping services is performed outside Canada?

8. What percentage (approximate) of your surveying and mapping services budget has been allocated to each of the sectors listed below over the last five fiscal years ending during the listed calendar years?

	1979	1980	1981	1982	1983
Cadastral Surveys					
Geodesy & Control Surveys					
Photogrammetric Mapping					
Hydrography					
Cartography					
Geographic Information Services					
Engineering Surveys					
Mining Surveys					
Remote Sensing (including aerial photography)					
Geophysical Surveys					
Other (please specify)					
Totals					

9. On the average how many people engaged in surveying and mapping were employed by your organization in the following years?

1979	1980	1981	1982	1983

10. How many personnel do you currently have on staff in each of the listed categories? Where personnel were engaged in more than one category, indicate only primary activity.

	PROFESSIONAL	TECHNICAL
Cadastral Surveys		
Geodesy & Control Surveys		
Photogrammetry		
Hydrography		
Cartography		
Geographic Information Services		
Engineering Surveys		
Mining Surveys		
Remote Sensing		
Geophysical Surveys		
Other (please specify)		
Total	+	= _____

In addition to the above, how many administrative staff in support of the above are currently employed by your organization? _____

Total all staff. _____

11. How many personnel currently on your staff have the following qualifications (personnel may be listed more than once):

_____ Professional Land Surveyor (eg BCLS, OLS, CLS, etc.)

_____ Professional Engineers (surveying)

_____ Other related professional qualifications

_____ Certified Technicians and Technologists (surveying)

_____ Other

12. How many personnel currently on your staff have the following surveying and mapping related academic qualifications (list the highest qualification only):

_____ Post Graduate degree or diploma

_____ Bachelor degree

_____ Technologist diploma

_____ Technician diploma

_____ High School

13. What was the book value (in dollars) of your organization's surveying and mapping technical equipment at the end of the five fiscal years ending during the listed calendar years?

1979	1980	1981	1982	1983
_____	_____	_____	_____	_____

14. What is the current replacement value (in dollars) of your organization's surveying and mapping technical equipment?

_____

15. This completes the questionnaire, but we would appreciate having your comments on some or all of the following:

(a) What new areas of expertise should surveying and mapping firms be expanding into?

(b) What technological advances are having the most impact on your organization and how do you see these developing?

(c) What areas of surveying and mapping should research and development priority be given to?

(d) What is the approximate dollar value of research and development carried out by your organization?

(e) Do you make use of any government of Canada agencies in research and development or other programs?

(f) Do you see a need for the Canadian Institute of Surveying to be more active in the promotion of the private surveying and mapping industry? If so, how could this best be accomplished?

The Canadian Institute of Surveying
Task Force on the Surveying and Mapping Industry in Canada

INTERVIEW QUESTIONNAIRE

1. Interview No. Date: _____

   Name(s) of Interviewer(s) _____

   _____

   Name of Person Interviewed:

   Title or Position:

   Department or Company Name:

   Address:

   Telephone:

2. Description of Services:

3. Principal Business and Services:

4. Other Services:

5. Total number of employees engaged in Surveying and Mapping: _____

6. Major projects undertaken in the last 5 years?

7. What is your approximate annual budget for Surveying and Mapping?

8. What percentage of your total budget is for work done in house? _____

   What percentage of your total budget is for work contracted out? _____

9. What is your philosophy on contracting out?

10. Are you involved in providing or contracting for Surveying and/or Mapping services outside of Canada?

11. If so - describe type of work

    - location of work

    - clients

    - how do you develop sales?

    - who are your major competitors in foreign work?

    - what advantages do they enjoy in competing for work?

    - what disadvantages are you subject to in competing for work?

    - did you receive Government assistance?

    - is Government assistance required?

12. If not - are you interested in developing foreign work?

    - would you join a consortium?

    - is Government assistance required?

    - if so, what?

13. What is the potential for growth of the market for Surveying and Mapping services over the next decade?

    Domestic?

    Foreign?

14. What are the constraints to growth?

    Domestic?

    Foreign?

15. What are the opportunities for growth?

    Domestic?

    Foreign?

16. What action is required and by whom to expand and develop the domestic Surveying and Mapping Industry?

17. What action is required and by whom to expand and develop th foreign market for Surveying and Mapping services?

18. What is your assessment of the present interaction between Governments (Federal, Provincial, Municipal) and the Surveying and Mapping Industry?

19. Is the education of Surveyors and Mappers adequate?

    - technical?

    - professional?

    - if not, what changes are required?

20. What is the current technological status of surveying and mapping in Canada?

    - Strengths?

    - Weaknesses?

21. What is required in the way of research and development and innovation for Surveying and Mapping in Canada?

    - geo-data information systems

    - remote sensing

    - automated cartography

    - development of hardware

    - other

22. To what extent will Surveyors and Mappers become redundant because of technological change?
    - none
    - some
    - large

23. What other activities should surveyors and Mappers logically be engaged in and would this require some additional education and training?

24. Is there a need for an all-encompassing industry association?

    If so - why? - and how should it be organized?

    Could an expanded CIS fufill this role?

    What would be the mandate?

25. What do you consider to be the key concerns present in the industry which will affect future performance?

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THE CANADIAN INSTITUTE OF SURVEYING
ASSOCIATION CANADIENNE DES SCIENCES GÉODÉSIQUES

Dear

A Task Force Study on the Surveying and Mapping Industry has been initiated by the federal Department of Regional Industrial Expansion in co-operation with the Canadian Institute of Surveying, the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Association of Hydrographic and Ocean Surveying Industries and the Canadian Hydrographers Association. All of these organizations are making a financial commitment to the study, but the major funding is being provided by Regional Industrial Expansion.

The scope of work for the study includes the following:

1. Perspective: describing several key aspects of the industry; how it is structured, how it operates, its significance to the Canadian economy and its development to date. All types of surveying will be covered.

2. Prospects: describing the potential and growth of the market anticipated over the next decade by sector and the constraints and opportunities facing the industry.

3. Interactions: outlining and assessing the interaction among the players involved, namely the interface between governments and industry, the pros and cons of a unified industry association and the potential for greater co-operation.

4. Issues: outlining key concerns present in the industry which will affect future performance, e.g. innovation and R&D, technology and education.

..2

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The Study is being coordinated by the Canadian Institute of Surveying, and Task Force members have been appointed as follows:

W.D. Usher, Chairman of the Task Force
Dr. G. Lachapelle, President of CIS
Dr. J. McLaughlin, President of CCLS
D.W. McLarty, President of CAAS
J.D. Barber, Vice President of CIS
G. Beliveau, Private Industry Representative
J.B. O'Neill, Executive Manager of CIS
E.A. Dixon, Recording Secretary of the Task Force.

This study of the Surveying and Mapping Industry in Canada will be the most extensive and comprehensive ever undertaken. The aim of the study is to determine the industrys' strengths and weaknesses, and to describe the constraints and opportunities for the industry both domestically and internationally.

The Task Force has identified a number of leaders in the Surveying and Mapping industry who they are inviting to assist in the study. As one of those leaders, we invite you to submit to the Task Force in the form of a brief, or letter, your views on some or all of the following:

1. What are the constraints and opportunities facing the industry with respect to the potential and growth of the market, both domestic and foreign, over the next decade?

2. What is your assessment of the interaction between government and industry? Is it satisfactory? Do you suggest any changes?

3. Education of persons engaged in Surveying and Mapping - is it adequate at both the technical and professional levels? If not, what changes are required?

4. What is the current technological status of the industry? What are the industrys' technical strengths and weaknesses?

5. Can governments assist in the development of the industry both domestically and internationally? If so, how?

6. Has there been adequate research in Surveying and Mapping? If not, can you suggest some priorities?

7. What other activities should the Surveying and Mapping industry logically be engaged in? (e.g. information systems, land use planning, etc.)

8. Other comments.

The members of the Task Force wish to emphasize the importance of this study to the whole Surveying and Mapping industry in Canada, and to all those individuals engaged in it. The success of the study will depend to a large extent on the help and co-operation of all of us.

We would appreciate receiving your submission prior to June 15, 1984. Please contact me at the above address, or phone me at (403) 434-3592, if you have any questions or if you require any additional information.

The final report is scheduled for completion by February 28, 1985. The report will be widely distributed, and will be made available to any who request it.

We thank you for your assistance and co-operation.

Yours truly,

W.D. Usher,
Chairman,
Task Force Study on the Surveying
and Mapping Industry in Canada.

APPENDIX 2

Respondents to Questionnaire No. 2

QUESTIONNAIRE 2

Questionnaires returned:

Q2-1: Manitoba Dept. of Natural Resources, Surveys and Mapping Branch.

Q2-2: Engineering and Surveys Branch, City of Ottawa.

Q2-3: City Engineering Dept., London, Ont.

Q2-4: Ville de Montréal

Q2-5: Canadian Hydrographic Service, Ottawa.

Q2-6: Land Resources Data Systems Branch, Environment Canada, Hull.

Q2-7: Winnipeg Land Titles Office, Manitoba.

Q2-8: Geography Division, Statistics Canada, Ottawa.

Q2-9: Realty Service Branch, Ministry of Government Services, Toronto, Ontario.

Q2-10: Public Service Commission of Halifax

Q2-11: Chief Surveyor's Office, Regina

Q2-12: PEI Dept. of Agriculture

Q2-13: Land Registration & Information Service, N.B.

Q2-14: Surveys & Resource Mapping Branch, Victoria, B.C.

Q2-15: Central Mapping Agency, Municipality of Metro Toronto.

Q2-16: N.B. Dept. of Transportation, Right of Way Branch, Fredericton.

Q2-17: Engineering Dept., City of Calgary

Q2-18: Ministry of Transportation & Highways, Victoria

Q2-19: Transport Canada, Western Region, Edmonton

Q2-20: Ontario Centre for Remote Sensing, Toronto

Q2-21: Mapping Service, Surveys & Mapping Branch, Ministry of Natural Resources, Toronto

Q2-22: Surveys Section, Surveys and Mapping Branch, Ministry of Natural Resources, Toronto

Q2-23: Geographical Referencing Section, Surveys and Mapping Branch, Ministry of Natural Resources, Toronto

Q2-24: Saskatchewan Energy and Mines, Regina

Q2-25: Ministry of Transportation & Communications, Downsview, Ontario

Q2-26: Highways & Transportation Dept., Land Surveys Division, Winnipeg

Q2-27: Legal and Survey Standards Branch, Ministry of Consumer and Commercial Relations, Toronto

Q2-28: Land Registration Improvement Project, Ministry of Consumer and Commercial Relations, Toronto

Q2-29: Saskatchewan Environment, Regina

Q2-30: Earth Physics Branch, Energy Mines and Resources, Ottawa.

Q2-31: Saskatchewan Rural Development, Regina

Q2-32: Saskatchewan Regional Office, E.M.R., Regina

Q2-33: Lands Branch, Regina

Q2-34: Alberta Bureau of Surveying and Mapping, Edmonton

Q2-35: Direction Générale du Domaine Territorial, Québec

Q2-36: Inventory Section, Forest Management Branch, Parks and Renewable Resources, Prince Albert

Q2-36/2: Construction Services Branch, Parks & Renewable Resources, Regina

Q2-36/3: Fisheries Branch, Parks & Renewable Resources, Regina

Q2-36/4: Wildlife Branch, Parks & Renewable Resources, Regina

Q2-37: Property Services Branch, Alberta Transportation, Edmonton

Q2-38: Roads and Traffic Department, Municipality of Metropolitan Toronto,

Q2-39: Operational Planning, Alberta Transportation, Edmonton

Q2-40: Central Survey & Mapping Agency, Sask. Supply & Services, Regina

Q2-41: Land Surveys and Real Estate Department, City of Winnipeg

Q2-42/1: Engineering Division, Dept. of Highways & Transportation, Regina

Q2-42/2: Operations Branch, Saskatchewan Highways and Transportation, Regina.

Q2-43: Works Department, City of Etobicoke, Etobicoke

Q2-44: Metro Toronto Works Dept., Engineering & Planning Div., Toronto

Q2-45: Saskatchewan Urban Affairs, Prince Albert

Q2-46: City of North York, Public Works Dept., North York, Ont.

Q2-47: Bureau de la cartographie et des arpentages, Ste-Foy

Q2-48: Resource Planning Division, Alberta Agriculture, Lethbridge.

Q2-49: Institute of Ocean Sciences, Canadian Hydrographic Service, Sidney, B.C.

Q2-50: Lands Branch, Dept. of Forest Resources & Lands, St. John's, Nfld.

Q2-51: Nova Scotia Department of Lands & Forests

Q2-52: Surveys & Mapping Branch, Earth Sciences Sector, E.M.R., Ottawa

Q2-53: Mapping & Charting Establishment, National Defence, Ottawa

Q2-54: Ministry of Forests, Engineering Branch, Victoria.

Q2-55: Survey Subsection, Water Management Branch, Victoria

Q2-56: Real Estate Services, Public Works Canada, Ottawa.

APPENDIX 3

Respondents to Questionnaire No. 3

QUESTIONNAIRE 3

Questionnaires returned:

Q3-1: Shell Canada Resources Ltd., Calgary

Q3-2: AMOCO Canada Petroleum Co. Ltd., Calgary

Q3-3: Northwestern Utilities Limited, Edmonton

Q3-4: PanCanadian Petroleum Ltd., Calgary

Q3-5: Texaco Canada Resources Ltd., Calgary

Q3-6: Newfoundland Light & Power Co. Limited, St. John's

Q3-7: Western Geophysical Co., Calgary

Q3-8: Gaz Métropolitan, Montreal

Q3-9: Saskatchewan Water Corporation, Regina

Q3-10: Saskatchewan Telecommunications, Regina

Q3-11: Northern Canada Power Commission, Edmonton

Q3-12: Alberta Power Ltd., Edmonton

Q3-13: Bell Canada, Ontario Region, Toronto

Q3-14: Dome Survey, Dome Petroleum, Calgary

Q3-15: Papeterie Reed Ltee, Quebec

Q3-16: Chevron Canada Resources Ltd., Calgary

Q3-17: Hydro-Québec, Direction Ingénierie de lignes, Montréal

Q3-18: Hydro-Québec, Direction Ingénierie de centrales, Montréal

Q3-19: Bell Canada, Montréal

Q3-20: Esso Resources Canada Ltd., Calgary

APPENDIX 4

Briefs Submitted

BRIEFS

Briefs Returned:

B-1: McConnell, Maughan Limited, Oakville

B-2: J.D. Mollard and Associates

B-3: University of Alberta

B-4: The City of Calgary

B-5: Canadian Hydrographic Service (Atlantic Region)

B-6: Dept. of Attorney-General, Land Titles Office, Manitoba

B-7: Stewart, Weir & Co., Edmonton

B-8: Public Service Commission of Halifax

B-9: Texaco Canada Resources, Calgary

B-10: J.D. Boal, S & M Br., Ottawa

B-11: D.A. Duffy, W.D. Usher & Assoc., B.C.

B-12: Design Engineering Br., Alta. Transportation, Edmonton

B-13: Kenting Earth Sciences Ltd., Ottawa

B-14: Marshall Macklin Monaghan Limited, Don Mills

B-15: Corporation of Land Surveyors of the Prov. of B.C., Victoria

B-16: Saskatchewan Agriculture, Regina

B-17: Surveys & Plans Office, Min. of Trans. & Comm., Downsview

B-18: Surveys & Mapping Br., Min. of Nat. Res., Ont.

B-19: Webb Surveys, Saskatoon

B-20: E.M.R., Surveys & Mapping Br., Ottawa

B-21: Nova Scotia Land Survey Inst.

B-22: Planning & Inventory Br., Ministry of Forest, Victoria

B-23: Alta. Bureau of Surveying & Mapping, Edmonton

B-24: Cansite Surveys Ltd., Calgary

B-25: University of Toronto, Survey Science, Mississauga

B-26: Swanby Surveys Ltd., Calgary

B-27: Gregory Geoscience Limited, Ottawa

B-28: Northern Alta. Inst. of Technology, Edmonton

B-29: Barnes & Duncan, Winnipeg

B-30: Assistant Director (Surveys), Ottawa (G. Babbage)

B-31: Saskatchewan Research Council, Saskatoon

B-32: Shell Canada Resources Ltd., Calgary

B-33: Chevron Canada Resources Ltd., Calgary

B-34: A.C. Hamilton, U.N.B.

B-35: Realty Services Branch, Toronto

B-36: B. Bishop, Alta.

B-37: Le Conseil des Entreprises de Levés Cartographiques du Québec (CELCQ)

B-38: Esso Resources Canada Ltd., Calgary

B-39: Alberta Land Surveyors' Association, Edmonton

B-40: Institute of Ocean Sciences, Sidney, British Columbia

B-41: L'Ordre des Arpenteurs - Géomètres du Québec, Ste-Foy, Qué.

B-42: Bird and Hale Ltd. - Toronto

B-43: Ian M. Hale, Program Director, Ryerson Polytechnical Institute - Toronto

B-44: The Association of Ontario Land Surveyors, Willowdale, Ontario

B-45: Z. Jaksic, Head, Photogrammetric Research, N.R.C., Ottawa.

APPENDIX 5

Interviews by Task Force

INTERVIEWS BY THE TASK FORCE

1. J.R. Depper, Terra Surveys Ltd. - Ottawa, Ont.
2. J.S. Simpson, McElhanney Mapping Services - Ottawa, Ont.
3. R.E. Moore, Surveys & Mapping Branch, E.M.R. - Ottawa, Ont.
4. S.B. MacPhee, Canadian Hydrographic Service - Ottawa, Ont.
5. J. Walker, Kenting Earth Sciences Ltd. - Ottawa, Ont.
6. G.K. Allred, Canadian Council of Land Surveyors - Edmonton, Alta.
7. E.J. Krakiwsky, Dept. of Surveying Engineering, U. of C. - Calgary, Alta.
8. J. McMurchy, The Orthoshop - Calgary, Alta.
9. E.J. Clark, Clark Swanby & Company - Calgary, Alta.
   R.J. Fulton, Alberta Land Surveyors Association - Calgary, Alta.
10. W.A. Wolley-Dod, Wolley-Dod & MacCrimmon Surveys Ltd. - Calgary, Alta.
11. E.A. Kennedy, et al., Alberta Bureau of Surveying and Mapping - Edmonton, Alta.
12. R.L. Simpson, Land Registration and Information Service - Fredericton, N.B.
13. E. Robinson, Land Registration and Information Service - Fredericton, N.B.
14. A.C. Hamilton, Dept. of Surveying Engineering, U.N.B. - Fredericton, N.B.
15. D.B. Wells, Dept. of Surveying Engineering, U.N.B. - Fredericton, N.B.
16. E.E. Derenyi, Dept. of Surveying Engineering, U.N.B. - Fredericton, N.B.
17. E. Smith, Key Surveys Ltd. - Moncton, N.B.
18. N. Nandlall, Director of Surveys, Department of Natural Resources - Fredericton, N.B.

19. J.F. Doig, Nova Scotia Land Survey Institute - Lawrencetown, N.S.
D.F. Woolnough, Nova Scotia Land Survey Institute - Lawrencetown, N.S.

20. A.E. Wallace, Wallace, Macdonald & Lively - Bedford, N.S.

21. K.P. AuCoin, Director of Surveys, Dept. of Lands & Forests - Halifax, N.S.

22. A.A. White et al., Cities of Halifax and Dartmouth - Halifax, N.S.

23. D. Steeves, Servant, Dunbrack, McKenzie & McDonald Ltd. - Halifax, N.S.

24. R. Crutcher, Geodata Ltd. - St. John's, Nfld.

25. N.G. MacNaughton, Director of Surveys, Newfoundland - St. John's, Nfld.

26. I. Ford, Newfoundland Land Surveyors Assoc. - St. John's, Nfld.

27. R. Whiffen, R. Whiffen & Associates - St. John's, Nfld.

28. P. Brown, Brown and Cave Surveys Ltd. - St. John's, Nfld.

29. M. Gaudreault, Aero Photo Inc. - Ste-Foy, Qué.

30. B. Monaghan, Monaghan et Associés - Ste-Foy, Qué.

31. M.P. Nadeau et al., Direction des Levés Legaux - Québec City, Qué.

32. M.M. Paradis, Direction des Relevés Tech. - Ste-Foy, Qué.

33. M. Brunet, Brunet, Léger, Léger - Longueuil, Qué.

34. Jean-Marc Daoust, et al., Hydro-Québec - Montréal, Qué.

35. Jean-Pierre Toutant, Hydro-Québec - Montréal, Qué.

36. M.R. Provencher, Directeur d'Arpentage, Ville de Montréal - Montréal, Qué.

37. G. Richardson, Institute of Ocean Sciences - Sidney, B.C.

38. G.T. Mullin, et al., Surveyor General, Ministry of Lands, Parks & Housing - Victoria, B.C.

39. K.D. Mawle, Butterfield, Hughes & Mawle - Victoria, B.C.

40. W.H. Morton, McElhanney Associates - Vancouver, B.C.

41. M.G. Thompson, Scobbie and Associates - New Westminster, B.C.

42. K. Frankich, British Columbia Institute of Technology - Burnaby, B.C.

43. W.G. Robinson, Underhill & Underhill - Vancouver, B.C.

44. J.W. Powers, et al., B.C. Hydro - Vancouver, B.C.

45. J. MacDonald, MacDonald Dettwiler & Assoc. Ltd. - Richmond, B.C.

46. R.W. Leeman, W.D. Usher & Associates, Ltd. - Edmonton, Alta.

47. Z. Zaksic, Division of Physics, National Research Council - Ottawa, Ont.

48. A.F. Gregory, Gregory Geoscience Limited - Ottawa, Ont.

49. G.T. & D.F. Yates, Yates & Yates Ltd. - Willowdale, Ont.

50. R.A. Smith, Central Mapping Agency, Metro Toronto - Toronto, Ont.

51. J.W. Monaghan, Marshall, Macklin & Monaghan Ltd. - Don Mills, Ont.

52. G.R. Douglas, Canadian Hydrographic Service - Burlington, Ont.

53. G. Gracie & R.C. Gunn, Erindale College, U. of T. - Mississauga, Ont.

54. M.J.M. Maughan & K.H. McConnell, McConnell Maughan Ltd. - Oakville, Ont.

55. T. Seawright, et al., Land Titles Office - Toronto, Ont.

56. I.M. Hale, Bird and Hale Limited - Toronto, Ont.
I.M. Hale, Ryerson Polytechnical Institute - Toronto, Ont.

57. S.E. Daykin, Northway-Gestalt Corporation - Toronto, Ont.

58. W. Brubacker & L. Petzold, Assoc. of Ontario Land Surveyors - Willowdale, Ont.

59. J. H. O'Donnell, Director, Surveys & Mapping Branch - Toronto, Ont.

60. W. Robertson, et al., Canadian Petroleum Association - Calgary, Alta.

61. J. Rasmuson, JTR Survey Services Ltd. - Calgary, Alta.

62. J.M. Zarzycki, Surveys and Mapping Branch, E.M.R. - Ottawa, Ont.

63. R. Groot, Director of Geographical Services, E.M.R. - Ottawa, Ont.

64. M.A. Schindler, Dipix Systems Limited - Ottawa, Ont.

65. R.A. Ryerson, Canada Centre for Remote Sensing - Ottawa, Ont.

66. S. Masry, Universal Systems Ltd. - Fredericton, N.B.

67. D.W. Seaborn, Systemhouse Graphics Systems Ltd. - Ottawa, Ont.

68. J.F. Wightman, Nova Scotia Land Survey Institute - Lawrencetown, N.S.

69. J. Byrne, Underwood McLellan Ltd. - Edmonton, Alta.

70. C.H. Weir, President, International Federation of Surveyors (F.I.G.) - Edmonton, Alta.

71. A.D. Hosford, North West Survey Group - Edmonton, Alta.

72. W.V. Blackie, Surveyor General - Ottawa, Ont.

73. R.A. Boyle, University of Saskatchewan - Saskatoon, Sask.

74. T. Webb, Webb Surveys - Saskatoon, Sask.

75. N. Nicholson, George, Nicholson, Franko & Associates - Saskatoon, Sask.

76. W. Stockton, Saskatchewan Land Surveyors Association - Regina, Sask.

77. J.B. Turnbull, Director, Central Survey and Mapping Agency - Regina, Sask.

78. C.C. Everett, Prairie Surveys Ltd. - Regina, Sask.

79. J. Condon, Condon Surveys Ltd. - Regina, Sask.

80. D.C. Crandall, Director of Surveys - Winnipeg, Man.

81. J.T. Wood and J.R. Bowman, Wilson & Neal - Winnipeg, Man.

82. C.N. Duncan, Barnes & Duncan - Winnipeg, Man.

83. H.E. Hodge, Airquest Resource Surveys Ltd. - Winnipeg, Man.

84. C. Bricker & K. Campbell, Alberta Remote Sensing Center - Edmonton, Alta.

85. R.E.D. McCuaig, Stewart, Weir and Co. - Edmonton, Alta.

86. Export Development Corporation - Ottawa, Ont.

87. Canadian International Development Agency - Ottawa, Ont.

APPENDIX 6

Educational Institutions

Educational Institutions Offering Surveying and Mapping Programs

Universities

- University of New Brunswick - Surveying Engineering
- Laval University - Survey Science
- University of Toronto, Erindale Campus - Survey Science
- University of Calgary - Surveying Engineering
- University of Alberta - Survey Science

Technical University

- Ryerson Polytechnical Institute - Toronto, Ontario

Technical Institutes, Colleges and CEGEP's

- Algonquin College of Applied Arts - Ottawa, Ont.
- British Columbia Institute of Technology - Burnaby, B.C.
- Camosun College - Victoria, B.C.
- CEGEP d'Ahunstic - Montréal, Qué.
- CEGEP de Limoilou - Québec City, Qué.
- CEGEP de l'Outaouais - Hull, Qué.
- The College of Trades and Technology - St. John's, Nfld.
- The Confederation College of Applied Arts and Technology - Thunder Bay, Ont.
- The Fanshawe College of Applied Arts and Technology - London, Ont.
- The Georgian College of Applied Arts and Technology - Toronto, Ont.
- Humber College of Applied Arts and Technology - Rexdale, Ont.
- Keewatin Community College - The Pas, Man.
- Loyalist College of Applied Arts and Technology - Belleville, Ont.
- Malaspina College - Nanaimo, B.C.
- New Caledonia Community College - Prince George, B.C.
- Niagara College of Applied Arts and Technology - Welland, Ont.
- Northern Alberta Institute of Technology - Edmonton, Alta.
- Northern College of Applied Arts and Technology - South Porcupine, Ont.
- Nova Scotia Land Survey Institute - Lawrencetown, N.S.
- Olds College - Olds, Alta.
- Red River Community College - Winnipeg, Man.
- Saskatchewan Technical Institute - Moose Jaw, Sask.
- Sir Sandford Fleming College of Applied Arts and Technology - Lindsay, Ont.
- Southern Alberta Institute of Technology - Calgary, Alta.